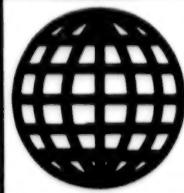


JPRS-UST-95-016

10 April 1995



FOREIGN  
BROADCAST  
INFORMATION  
SERVICE

# ***JPRS Report—***

## **Science & Technology**

---

***Central Eurasia***

This report may contain copyrighted material. Copying and dissemination  
is prohibited without permission of the copyright owners.

# Science & Technology

## Central Eurasia

JPRS-UST-95-016

### CONTENTS

10 April 1995

#### COMPUTERS

- Sections Technology in Parallel Computer Tomography  
[Ye. G. Sukhov; Moscow AVTOMATIKA I TELEMEKHANIKA No 12, Dec 94] ..... 1

#### ELECTRONICS

- Deep Interference Fading of Millimetric Waves With Back Reflection Along Direct Visibility Path  
[G.A. Andreyev, G.A. Gladyshev; Moscow RADIOTEKHNIKA I ELEKTRONIKA, Vol 40 No 1, Jan 95] ..... 2
- Radiation Emission From Conformal Aperture of Antenna Mounted on Cylinder of Finite Length  
[D.D. Gabrielyan, M.Yu. Zvezdina; Moscow RADIOTEKHNIKA I ELEKTRONIKA, Vol 40 No 1, Jan 95] ..... 2
- Method of Signal Reconstruction From Modulus of Amplitude Spectrum  
[R.A. Svetkovskiy; Moscow RADIOTEKHNIKA I ELEKTRONIKA, Vol 40 No 1, Jan 95] ..... 2
- Electroacoustic Transducer of Electric Field of Individual Microwave Radio Pulses  
[A.V. Yermolenko, B.D. Zaytsev, et al; Moscow RADIOTEKHNIKA I ELEKTRONIKA, Vol 40 No 1, Jan 95] ..... 3
- Estimating Coherence Intervals in Highly Stable Oscillations of Millimetric-Wave Sources  
[D.V. Bogomolov, D.S. Ochkov; Moscow RADIOTEKHNIKA I ELEKTRONIKA, Vol 40 No 1, Jan 95] ..... 3
- Using High-frequency and Ultrahigh-Frequency Plasma Discharges in Production of Optical Quartz Fibers  
[L.M. Blinov, V.V. Volodko, et al; Moscow RADIOTEKHNIKA I ELEKTRONIKA, Vol 40 No 1, Jan 95] ..... 3
- Biaxial Compression in Thin Gallium Arsenide Films Grown on Silicon  
[V.A. Ioshkin, A.A. Orlikovskiy, et al; Moscow MIKROELEKTRONIKA Vol 24 No 1, Jan-Feb 95] ..... 4
- Mathematical Simulation of Submicron GaAs Gunn Diode With Tunnel Resonance Injector  
[O.A. Kartashova, G.Yu. Khrenov; Moscow MIKROELEKTRONIKA Vol 24 No 1, Jan-Feb 95] ..... 4
- High-Frequency Capacitance-Voltage Measurements in Thin-Film Epitaxial Gallium Arsenide Structures  
[N.B. Gorev, T.V. Makarova, et al; Moscow MIKROELEKTRONIKA Vol 24 No 1, Jan-Feb 95] ..... 4
- Development of Defects on Surface of SIMOX Structures During High-Temperature Annealing  
[S.A. Krivelevich, M.I. Makoviychuk, et al; Moscow MIKROELEKTRONIKA Vol 24 No 1, Jan-Feb 95] ..... 5
- Properties of Solitons Describable by the Generalized Equation of Quasi-Optics  
[N.N. Rozanov; St. Petersburg OPTIKA I SPEKTROSKOPIYA, Vol 78 No 1, Jan 95] ..... 5
- Pseudodeep Hologram With Real Physical Recording Depth  
[Yu.N. Denisyuk, N.M. Ganzherli, et al; St. Petersburg OPTIKA I SPEKTROSKOPIYA, Vol 78 No 1, Jan 95] ..... 5

#### TELECOMMUNICATIONS

- S&T Telecommunications Networks to be Self-Financed  
[M. Isayev; Moscow POISK No 9, 4-10 Mar 95] ..... 7

#### ENGINEERING AND EQUIPMENT

- Plan to Recycle Nuclear-Powered Ship Components Described  
[I. Shilenkov; Moscow INZHENER, No 9, Sep 94] ..... 8

#### LIFE SCIENCES

- Analysis of Cellular and Humoral Mechanisms of the Antiradiation Effect of the Preparation NS-1539  
[V.G. Lebedev, T.V. Vorotnikova, et al; Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA No 3, Jul-Sep 94] ..... 9

Protective Effect of $\beta$ -1,3-Carboxymethylglucan Fraction in Acute Massive Blood Loss <i>[Ye.I. Vereshchagin, T.A. Korolenko, et al; Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA, No 3, Jul-Sep 94]</i>	9
Comparative Efficacy of the Peptide Preparations Finoptin, Levamisole, and Prednisolone in Experimental Immune Cardiogenic Shock <i>[T.I. Grekova, V.A. Shaydarova, et al; Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA No 3, Jul-Sep 94]</i>	9
Use of Chitosan-Based Liquid Sorbents for Treatment of Diffuse Peritonitis <i>[I.N. Bolshakov, S.M. Nasibov, et al; Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA No 3, Jul-Sep 94]</i>	10
On Introducing Changes in and Supplements to Terms of Wages of Public Health Workers (Order No 28 Dated 17 February 1994) <i>[Moscow VRACH No 8, Aug 94]</i>	10
Central and Peripheral Effect of Delta Sleep Inducing Peptide on Cardiac Electric Stability <i>[M.I. Arkhangelskaya; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	12
Influence of Narcosis on Effect of Acute Experimental Poisoning of Animals by Pesticide Antio ("Sandoz") From Group of Organophosphorus Compounds <i>[I.A. Tarakanov, Ya.K. Kurambayev, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	13
Research on Apathogenic Strains of <i>F. tularensis</i> , <i>B. abortus</i> and <i>Y. pseudotuberculosis</i> as Producers of Recombinant $\beta$ -Endorphin <i>[V.M. Borzenkov, A.P. Pomerantsev, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	13
Obtaining Monoclonal Antibodies to O-Antigen of <i>Salmonella Typhimurium</i> Serum Group B (0-4.5) <i>[M.V. Rayevskaya, N.V. Kovalchuk, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	13
Obtaining and Describing Mice Monoclonal Antibodies to K-Antigen of <i>Salmonella Typhimurium</i> <i>[M.V. Rayevskaya, Yu.A. Belya, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	14
Microbiologic Criteria for Evaluating Ecologic Risk <i>[V.Yu. Sokolov; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	14
Antiopsonic Effect of Extracellular Products of Staphylococci <i>[O.V. Bukharin, D.G. Deryabin, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	15
Stem Blood-Forming Cells With Introduced Foreign Gene—Proliferative Activity and Potential at Remote Times After Transplantation to Irradiated Mice <i>[I.L. Chertkov, N.I. Drize, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	15
Impact of Low-Intensity Luminescent Radiation on Regeneration Processes in Skin Wounds of Rats <i>[V.A. Monich, B.Ye. Shakhov, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY, Vol 117 No 6, Jun 94]</i>	15
Research on Transcription of Cerebral Cortex Neurons of Rats Under Homo- and Heterotopic Transplantation Conditions at Different Times of Postnatal Ontogenesis <i>[O.V. Bulchuk, A.V. Grigoryeva, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	16
Influence of Monochromatic Light of Red and Near-IR Spectral Regions on Adhesive Properties of Cell Membrane: Dependence on Wavelength <i>[T.Y. Karu, L.V. Pyatibrat, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 117 No 6, Jun 94]</i>	16
Forecasting Possibility of Primary Manifestation of Spike Fusariosis (Pathogen <i>Fusarium Graminearum</i> ) <i>[V.I. Terekhov, N.I. Fissura, et al; Moscow DOKLADY ROSSIYSKOY AKADEMII SELSKOKHOZYASTVENNYKH NAUK No 6, Nov-Dec 94]</i>	16
Mental and Vegetosomatic Disorders Due to Long-Term Exposure to Low Doses of Radiation <i>[S.V. Golovenko; Moscow ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA Vol 94 No 4, Jul-Aug 94]</i>	19
Mental and Neurological Health of the Child Population in Some Parts of Ukraine After the Accident at the Chernobyl Nuclear Power Plant <i>[V.S. Podkorytov, V.V. Filyk, et al; Moscow ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA Vol 94 No 4, Jul-Aug 94]</i>	22

Mental Health of the People of the Russian Federation <i>[Moscow ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA Vol 94 No 4, Jul-Aug 94]</i>	25
Method of Storing and Shipping Bacterial Cultures Using Paper Disks <i>[Yu.M. Feldman, L.G. Makhaneva; Moscow KLINICHESKAYA LABORATORNAYA DIAGNOSTIKA No 5, May 94]</i>	40
Accreditation of Clinical Diagnostic Laboratories <i>[Moscow KLINICHESKAYA LABORATORNAYA DIAGNOSTIKA No 5, May 94]</i>	41
Organization of Specialized Emergency Medical Assistance at N. N. Budenko Main Military Clinical Hospital <i>[V.M. Klyuzhev, N.L. Krylov, et al; Moscow VOYENNO-MEDITSINSKIY ZHURNAL No 10, Oct 94]</i>	44
Using Mafusol in Acute Loss of Blood <i>[M.I. Rudenko, V.N. Andryushkin, et al; Moscow VOYENNO-MEDITSINSKIY ZHURNAL No 10, Oct 94]</i>	49
Pathomorphological Aspect of Modern Explosion Trauma <i>[K.K. Zaytseva, M.A. Velichko, et al; Moscow VOYENNO-MEDITSINSKIY ZHURNAL No 10, Oct 94]</i>	50
Study of the Effect of Exogenous Acetylcholine on the Effectiveness of Nerve-Muscle Transmission in a Fatigued Rat Diaphragm <i>[I.V. Kubasov, I.I. Krivoy, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	57
Secondary Mediators in Amiridine Modulation of Neuronal Choline Receptors in <i>Helix lucorum taurica Kryn</i> <i>[Yu.V. Burov, A.S. Pivovarov, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	57
Effect of Immunization With Sheep Erythrocytes on Rat Behavior <i>[Yu.V. Burov, L.Ye. Davydova, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	57
Effective Expression of Apolipoprotein A1 Gene Transferred into Human Cells Growing Invitro <i>[V.Yu. Kuryshev, N.L. Drapchinskaya, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	58
Study of the Specificity of Monoclonal Antibodies Obtained in Immunization of Mice With a Culture of Streptococcus Group A Treated With Pepsin <i>[T.A. Danilova, T.K. Asoskova, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	58
Comparison of the Effectiveness of Cutaneous and Subcutaneous Administration of Tactin To Correct a Secondary Immunodeficient State in Young Children <i>[V.Ya. Arion, E.M. Beckman, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	58
Regulation of Therapeutic and Toxic Effects of Cardiac Glycosides With Electromagnetic Radiation and Variable Magnetic and Electric Fields <i>[A.T. Grechko; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	58
Effect of Synthetic Analogs of Dermorphine on Cell Division of the Epithelium of the Cornea and Tongue of White Rats <i>[M.Yu. Fleyshman, M.I. Radivoz, et al; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	59
Post-Irradiation Demyelinizing Changes in the Optic Nerve <i>[S.V. Loginov; Moscow BYULLEHEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY Vol 118 No 11, Nov 94]</i>	59
Basic Biological and Ecological Research <i>[V.Ye. Sokolov, A.N. Severtsov; Moscow VESTNIK ROSSIYSKOY AKADEMII NAUK Vol 64 No 9, Sep 94]</i>	59
Biodiversity—Key Problem of Biology. Discussion in RAS Presidium <i>[Moscow VESTNIK ROSSIYSKOY AKADEMII NAUK Vol 64 No 9, Sep 94]</i>	65
Comparative Characteristics of Preparations of <i>Yersinia pestis</i> Capsular Antigen FI Obtained From Producer Strains With Different Lipopolysaccharide Structures <i>[T.A. Gremyakova, V.N. Stepanshina, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII No 3, May-Jun 94]</i>	69

Heterogeneity of Populations of Recombinant Strain <i>Escherichia coli</i> KS 1561, a Producer of Thermolabile Enterotoxin, During the Process of Submerged Culturing <i>[L.D. Martynenko, A.V. Aleshukina, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	70
Search for and Isolation of <i>Francisella tularensis</i> Antiphagocyte Factor <i>[L.V. Larionova; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	71
Cloning and Expression of the β-Hemolysin Gene of <i>Staphylococcus aureus</i> <i>[V.Ye. Katerov, V.I. Golukov, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	71
Ecological and Epidemiological Aspects of the Spread of <i>Vibrio parahaemolyticus</i> in the Fresh Water Region <i>[A.V. Boyko, N.P. Pogorelova, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	72
Immunodiagnosis of Melioidosis by a Solid-Phase Variant of Radioimmunoassay <i>[N.N. Piven, A.D. Manolov, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	72
Lectin Activity of the Mussel Bioglycan Mytilan and Its Effect on Microbial Adhesion to Macroorganism Cells <i>[T.S. Zaporozhets, N.N. Besednova, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	73
Immunologic Criteria of Selecting Military Personnel for Service Under Extreme Conditions <i>[B.B. Pershin, S.N. Kuzmin, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	73
Effect of Antigen Fractions of the Outer Membrane of <i>Francisella tularensis</i> on Selected Indicators of T-Cell Immunity <i>[D.V. Skatov, V.G. Galaktionov, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	74
Situation Regarding the Cholera Epidemic Worldwide: Morbidity Analysis and Trends <i>[G.G. Onishchenko, Yu.M. Lomov, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	74
Socioeconomic Concept-Based System for Epidemic Process Simulations <i>[O.V. Zakharyashcheva, V.N. Krutko, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	79
Case of Laboratory Marburg Fever Infection <i>[V.V. Nikiforov, Yu.I. Turovskiy, et al; Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI No 3, May-Jun 94]</i>	84
Experimental Substantiation of the Use of Pharmaceuticals To Increase the Human Body's Resistance to the Combined Effect of Carbon Monoxide and Hyperthermia <i>[A.V. Sedov, T.A. Lukicheva, et al; Moscow MEDITSINA TRUDA I PROMYSHLENNAYA EKOLOGIYA No 9-10, Sep-Oct 93]</i>	87
RF Ministry of Health Announcement to Directors of Health Care Organizations <i>[V.I. Starodubov; Moscow MEDITSINA TRUDA I PROMYSHLENNAYA EKOLOGIYA No 9-10, Sep-Oct 93]</i>	88

**Sections Technology in Parallel Computer Tomography**

957A0363A Moscow AVTOMATIKA I  
TELEMEKHANIKA in Russian No 12, Dec 94  
(manuscript received 22 Dec 93) pp 163-168

[Article by Ye. G. Sukhov, candidate of physical and mathematical sciences, Control Problems Institute, Russian Academy of Sciences; UDC 681.324:61]

[FBIS Abstract] Computer tomography now plays an important role in the fields of gas dynamics, plasma physics, optics, quantum electronics and medicine. Two principal approaches are used: the first involves the ray approximation, whereas the second is a wave approach. Both require ultrahigh computer capabilities and the writing of appropriate algorithms (since traditional ones no longer are appropriate). A study was therefore made of the technological aspects of solution of tomography problems in parallel computer systems. A technology is proposed within the framework of the ray approach in

which parallelism of the scanning beam is assumed. The numerical methods of linear algebra are applied. The objective is to construct a general tomographic parallel numerical method common for all specific numerical methods used on a practical basis. First a physical model of absorption is outlined. This model corresponds to irradiation of the investigated object by a plane-parallel monochromatic beam and registry of the intensity of the transmitted radiation. The fraction of total absorption is easily determined. The determined absorptions are initial data for the retrieval problem. Then the "sections" (generalizations of one-dimensional subsets of matrix elements) are defined, their application is discussed and an illustrative example is given. The necessary compact numerical retrieval algorithm is written, requiring only simple procedures. The processing of the sections has a natural parallelism which can be realized using modern VLSI chip multiprocessors. An outline of the appropriate computer architecture is presented. References: 5 Russian.

**Deep Interference Fading of Millimetric Waves With Back Reflection Along Direct Visibility Path**

957A0387A Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 40 No 1, Jan 95  
(manuscript received 26 Oct 93) pp 12-17

[Article by G.A. Andreyev and G.A. Gladyshev; UDC 621.371:551]

[FBIS Abstract] Interference fading of millimetric waves at the receiver end of a direct-visibility path is analyzed theoretically by the method of geometrical optics, taking into account fluctuations of the refractive index of air and back-reflections of such waves by earth crust formations along such a path. Assuming a linear steady-state vertical profile of the refractive index and fluctuations of its gradient to be a complete cubic polynomial function of time (including a free term), the signal amplitude at the receiver end is calculated as a function of time. This calculation is based on the short-wave asymptotic solution to the wave equation and the corresponding equation of ray trajectories. Calculation of the interference pattern requires knowing the phase characteristics of the incident rays and is facilitated by use of the integral expression for the signal propagation time along the bundle of transmitter-to-receiver ray trajectories. The results of these calculations covering 60 s long periods of time are found to correlate with the results of measurements made in an experiment [G.A. Andreyev, A.S. Zakharov, A.G. Kleyn; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, Vol 20 No 3, 1983] using a meteorological pulsed 8 mm radar on the ground (transmitter power 60 kW, receiver sensitivity 116 dB/W, parabolic antenna 3 m in diameter) and a corner reflector (effective scattering area  $3700 \text{ m}^2$ ) mounted on a 46 m high tower 17 km away. They indicate that a gradient of the refractive index and its fluctuations along each ray trajectory within an atmospheric ground layer appreciably influence the propagation pattern of electromagnetic waves in such a layer. They furthermore indicate that the amplitude of millimetric signals at the receiver end also depends on the radiation pattern of the antenna. This dependence can be evaluated following a spectrum analysis which takes into account the spatial nonuniformity of the frequency characteristics of free space. Figures 2; references 5.

**Radiation Emission From Conformal Aperture of Antenna Mounted on Cylinder of Finite Length**

957A0387B Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 40 No 1, Jan 95  
(manuscript received 18 Feb 93) pp 34-39

[Article by D.D. Gabrielyan and M.Yu. Zvezdina; UDC 621.396.677]

[FBIS Abstract] Radiation emission by an antenna mounted on the lateral surface of an ideally conducting cylinder of large electrical dimensions and finite length is analyzed theoretically in the short-wave approximation.

Under consideration is specifically an antenna with the aperture oriented conformally to that cylinder and excitation of the latter by an incident plane electromagnetic wave the latter excited by a linearly polarized plane electromagnetic incident wave, the latter being represented as the superposition of two waves polarized in mutually orthogonal directions. The density of the electric current at the lateral surface of the cylinder is calculated in accordance with the physical theory of diffraction and its density at the outside surface of its end walls is calculated in accordance with the principles of physical optics. The distribution of the nonuniform current density component at the lateral surface of a finite cylinder is in the short-wave approximation described as a combination of longitudinally propagating edge waves and circumferentially propagating slip waves. The mathematical formulation of this proposition in the form of a compound series facilitates more precise accounting for the finite length of the cylinder and for internal rereflections of longitudinal waves by the two end walls as well as for the distribution of the nonuniform current density component. The results of numerical calculations indicate that the finite length of such a waveguide influences its radiation pattern most strongly in the elevation plane and more so upon excitation by an  $H_{10}$ -mode wave than by an  $H_{01}$ -mode wave. Figures 3; references 13.

**Method of Signal Reconstruction From Modulus of Amplitude Spectrum**

957A0387C Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 40 No 1, Jan 95  
(manuscript received 1 Nov 93) pp 75-79

[Article by R.A. Sventkovskiy; UDC 621.391]

[FBIS Abstract] An improvement of the Hershberg-Saxton iteration method of signal reconstruction [W.O. Saxton, R.W. Hershberg; OPTIK, Vol 35 No 3, 1972] is proposed, by using not only the phase spectrum but also the amplitude spectrum. The sought signal is the model of an echo signal returning from the target, say a cluster of bright point scatterers. On the first iteration step the target is assumed to consist of only one such point and its coordinate to be zero, whereupon the model of the target is being refined on subsequent steps. The errors contained in the amplitude (modulus) readings of the spectral components at various frequencies are assumed to be mutually independent and all to have a Gaussian distribution. This iteration method has been tested for convergence and speed, loss of convergence still being a problem when the coordinates of signal peaks are fixed and distance between peak pairs are multiples of one another. The seven-step iteration process includes identification and elimination of spurious peaks, which would slow down the process, and an additional procedure for refinement of the peak readings in the presence of weak noise. A statistical simulation of the iteration process has revealed that the phase spectrum is more informative than the amplitude spectrum. References 6.

### Electroacoustic Transducer of Electric Field of Individual Microwave Radio Pulses

957A0387D Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 40 No 1, Jan 95  
(manuscript received 11 Feb 94) pp 80-88

[Article by A.V Yermolenko, B.D. Zaytsev, V.Yu. Kalinin, I.Ye. Kuznetsova, and V.A. Fedorenko; UDC 621.317.088]

[FBIS Abstract] A new electroacoustic (electrostrictive) transducer for measuring the electric field intensity of microwave radio pulses is described which consists of an SAW delay line and two converters, one of them having a nonlinear response characteristic and the other a plain interdigital linear piezoelectric one inside an open shield. Upon placement of the nonlinear converter in a UHF field, a low-frequency acoustic pulse is generated in it and transmitted through a sound guide to the linear one. The transducer can be excited by volume acoustic waves and by surface acoustic waves. The performance in each case is analyzed theoretically for design optimization. The results indicate a much higher transducer sensitivity mV/(kV/cm) upon excitation by surface acoustic waves. In an experiment such a transducer was placed on a relativistic microwave oscillator of the ubitron type generating 4-5 kW radio pulses of 500 ns duration at the 3.9 cm wavelength. The transducer was also tested in the KhVTI laboratory. The authors thank I.I. Magda, N.P. Gadetskiy, and Yu.V. Prokopenko for assistance in conducting the experiments. Figures 5; references 11.

### Estimating Coherence Intervals in Highly Stable Oscillations of Millimetric-Wave Sources

957A0387E Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 40 No 1, Jan 95  
(manuscript received 24 Mar 93) pp 111-115

[Article by D.V. Bogomolov and D.S. Ochkov; UDC 621.373.5]

[FBIS Abstract] Three schemes are proposed for minimizing phase fluctuations and thus maximizing the coherence intervals in millimetric-wave radar signals, a difficult but necessary task to ensure phase stability of such signals. The first scheme is frequency conversion: multiplication of the frequency of a quartz oscillator specially designed and thermostatically controlled for maximum short-time frequency stability. The two other schemes are use of millimetric-wave oscillator and a centimetric-wave oscillator respectively, each oscillator stabilized with a dielectric disk resonator and also thermostatically controlled. The theory underlying these schemes is based on definition of the coherence interval as a period of time within which the dispersion of fluctuations of the phase difference between several successive oscillations does not exceed a certain limit, as the limit having been selected here 1 rad<sup>2</sup>. The length of this coherence interval can be and is determined here

from the dependence of that dispersion on the length of measurement time. The process, a random one, is regarded as phase modulation of a harmonic oscillation by a stationary normal noise. Analysis and numerical calculations made on this basis reveal a possibility of generating millimetric-wave oscillations with up to tenths of a second long coherence intervals. Figures 1; tables 1; references 7.

### Using High-frequency and Ultrahigh-Frequency Plasma Discharges in Production of Optical Quartz Fibers

957A0387F Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 40 No 1, Jan 95  
(manuscript received 20 May 94) pp 115-126

[Article by L.M. Blinov, V.V. Volodko, N.V. Kulikovskiy, A.M. Solomatin, I.P. Shilov, V. Neuberger, B. Grachev, Ts. Voytsekhovskiy, and V. Tsenden; UDC 539.284]

[FBIS Abstract] Production of extremely high-quality optical quartz fibers with the aid of plasma discharge is considered, such fibers being needed for operation with YAG power lasers in optical communication systems. Two variants of this technology are described, each one not only much more efficient than purely chemical deposition from the vapor phase (MCVD, CVD, VAD) but also facilitating a much more effective doping of quartz glass with new desirable modifiers and especially so with fluorine. The basic variant is internal deposition in an apparatus which includes a high-frequency atmospheric-pressure pulsed-discharge plasmatron excited by a high-frequency oscillator and followed by a neutralizer ( $\text{SiO}_{1.5}\text{F}$  molecules forming as a result of three chemical condensed-state reactions). With a 20 kW plasmatron has thus been attained 90% efficient deposition of fluorosilicate quartz glass on rotating quartz tubes at rates reaching 2.5 mg/min. The second variant is deposition of fiber-optic structures in a microwave-frequency low-pressure plasma discharge, the principal advantage of this process over plain internal deposition from the gaseous phase being that here the chemical reaction is activated not thermodynamically but at a relatively low gas temperature in a nonisothermal medium. This enhances the plasma's activation power and makes the reaction, a heterogeneous none, much less temperature dependent. The process yields optically transparent glass films. Contamination is preventable by vacuum shielding and hermetic sealing. With this method has been attained 100% efficient deposition of high-quality doped  $\text{SiO}_2$  glass at rates reaching 3 g/min rates and 80-90% efficient deposition of doped  $\text{GeO}_2$  glass at similarly high rates. Fiber specimens have already been produced capable of operation with high-power (up to 1 kW) continuous-wave YAG:Nd<sup>+++</sup> lasers. Production of conical fibers ("focons") for pulsed excimer lasers is still in the experimental stage, but here too promising results have been obtained with a specimen produced for a 9 mJ - 20 ns XeCl-laser. Figures 8; tables 1; 16 references.

**Biaxial Compression in Thin Gallium Arsenide Films Grown on Silicon**

957A0388A Moscow MIKROELEKTRONIKA  
in Russian Vol 24 No 1, Jan-Feb 95 (manuscript  
received 2 Dec 93) pp 3-12

[Article by V.A. Ioshkin, A.A. Orlikovskiy, V.N. Pavlenko, S.R. Oktyabrskiy, Ye.Yu. Dovydenko, A.V. Kvit, I.Kh. Mukhamedzhanov and E.M. Pashayev, Physical Technology Institute, Russian Academy of Sciences; Physics Institute, Russian Academy of Sciences; Crystallography Institute, Russian Academy of Sciences; UDC 621.382]

[FBIS Abstract] A study was made of the relaxation of the stresses arising at the interface in thin (0.3-3.0  $\mu\text{m}$ ) GaAs films grown on (001)Si substrates. The presence of biaxial compression was determined by two-crystal X-ray diffraction and analyses of Raman scattering, from absorption spectra in a reflection mode, induced photoluminescence spectra, characteristic lines of low-temperature photoluminescence spectra and the nature of the influence of mechanical stresses on the profile of line shifts accompanying low-temperature photoluminescence. When conducting fast thermal annealing in the temperature range from 560 to 700°C GaAs/(001)Si films experience increased compression, whereas at temperatures above 700°C they become more dilatated. Fast and slow thermal annealing result in a decrease in the density of dislocations and a peak of the oscillations curve (up to 260-420 s) regardless whether the deformation is negative or positive. Fast thermal annealing at  $T > 700^\circ\text{C}$  considerably decreases the misorientation angle of the GaAs film relative to the Si substrate. A model is proposed describing the observed effects. A new explanation is proposed for the origin of low-temperature fluorescence levels in stressed GaAs/(001)Si epitaxial layers. The dependence of the position of these peaks on the energy scale on stress agrees well with the computed dependence for recombination with the participation of light holes. Figures 9; references 18: 3 Russian, 15 Western.

**Mathematical Simulation of Submicron GaAs Gunn Diode With Tunnel Resonance Injector**

957A0388B Moscow MIKROELEKTRONIKA  
in Russian Vol 24 No 1, Jan-Feb 95 (manuscript  
received 18 May 94) pp 34-37

[Article by O. A. Kartashova and G. Yu. Khrenov, Physical Technology Institute, Russian Academy of Sciences; UDC 621.382]

[FBIS Abstract] An increase in the efficiency of submicron Gunn diodes can be attained by the injection of hot electrons into drift space, which is possible by complicating diode structure in several ways, but the most promising way to improve generation conditions, outlined here, is the introduction of a tunnel-resonance structure (TRS) as a hot electron injector ensuring a high

energy homogeneity of the electrons injected into the active region. In the course of the research a comparative analysis was made of the principal parameters of generation of the simulated diodes versus traditional submicron Gunn diodes and diodes with a notch. A kinetic approach was used and the kinetic equations were solved by the Monte Carlo method. In the simulation a study was made of the influence of TRS on generation frequency, on "dead zone" length and form of current oscillations. The minimum length of the diode channel in which generation is possible also was ascertained. An analysis of the results of mathematical simulation of short-channel Gunn diodes with a TRS in the cathode region indicated the following. The presence of a TRS in the cathode region of the studied instrument results in a shortening of the length of the "dead zone," resulting in a broadening of the frequency range in which the diode can operate as a generator. The electron transparency of the TRS is regulated by the space charge of the L-electrons outside the TRS, with the TRS functioning as an energy filter. In Ga-As Gunn diodes with a TRS in the cathode region there is Gunn generation at frequencies 150-700 GHz with channel lengths 1.0-0.3  $\mu\text{m}$ . The efficiency and stability of generation of the studied structures were greater than for submicron GaAs Gunn diodes with a notch. Figures 4; references 6: 1 Russian, 5 Western.

**High-Frequency Capacitance-Voltage Measurements in Thin-Film Epitaxial Gallium Arsenide Structures**

957A0388C Moscow MIKROELEKTRONIKA  
in Russian Vol 24 No 1, Jan-Feb 95 (manuscript  
received 17 Nov 93) pp 44-47

[Article by N.B. Gorev, T.V. Makarova, Ye.F. Prokhorov, A.T. Ukolov and V.I. Eppel, Technical Mechanics Institute, Ukrainian Academy of Sciences; UDC 621.382]

[FBIS Abstract] Use of V-C measurement methods for determining the doping profile of semiconductor structures when solving the inverse problem using a set of a priori profiles has gained popularity, but this approach requires considerable computer time and its applicability to all situations must be questioned. Accordingly, analytic computations were made of the high-frequency dependence of a thin-film epitaxial n-GaAs structure with a barrier contact on the film under conditions of adjacency of the regions of barrier impoverishment and the film-substrate transition. It was established that there is an asymptotic tendency of high-frequency capacitance to zero with an increase in barrier voltage regardless of the characteristics of film doping. An expression was derived which through high-frequency capacitance expresses the effective thickness of the film, representing the difference between the geometric thickness of the film and the extent of the region of impoverishment of the film-substrate transition. The importance of measuring interelectrode capacitance is stressed. In the case

of real C-V curves failure to take interelectrode capacitance into account results in appreciable quantitative and qualitative change in the form of the computed doping profile. The classical approach to the processing of the results of high-frequency C-V measurements in such thin-film epitaxial structures is valid only within the limits of the effective thickness of the film and measurements must therefore be made within such a range of voltages which will make it possible to determine the asymptotic capacitance level. Figures 2; references 5: 2 Russian, 3 Western.

### Development of Defects on Surface of SIMOX Structures During High-Temperature Annealing

957A0388D Moscow MIKROELEKTRONIKA  
in Russian Vol 24 No 1, Jan-Feb 95 (manuscript received 12 Mar 94) pp 77-80

[Article by S.A. Krivelevich, M.I. Makoviychuk, Ye.O. Parshin, M.N. Preobrazhenskiy and V.A. Rekshinskiy, Microelectronics Institute, Russian Academy of Sciences; UDC 621.382]

[FBIS Abstract] A study was made of the development of defects on the surface of a SIMOX structure during high-temperature (1100-1300°C) annealing leading to a substantial increase in internal thermoelastic stresses in the system associated with nonuniformity in the distribution of matter in the structure and a difference in the volume expansion coefficients during heating. The object of research was plates of silicon with an orientation (100) at whose center oxygen with an energy 1 MeV was implanted in a radius 10 mm. The implantation dose was  $10^{18} \text{ cm}^{-2}$ . After implantation the samples were annealed at a temperature 1200°C in an argon flow. Annealing was in stages with alternating periods of heating and cooling. The total time of thermal processing in these stages was about two hours. During these operations inspection was with an acoustic microscope; at the end of the experiment an electron microscope was used. A detailed stage-by-stage description is given of monitoring of the plates, in particular the development of pitting. Each such defect has a complex internal structure. A series of nine photographs illustrates the sequence of events, which are described in detail. The formation of two types of complexes is discussed and a model is proposed which makes possible a qualitative explanation of the results. Figures 3; references: 4 Russian.

### Properties of Solitons Describable by the Generalized Equation of Quasi-Optics

957A0389A St. Petersburg OPTIKA I  
SPEKTROSKOPIYA in Russian Vol 78 No 1, Jan 95  
(manuscript received 27 Jul 94) pp 88-91

[Article by N.N. Rozanov, Institute of Laser Physics at State Science Center "State Institute of Optics imeni S.I. Vavilov," St.Petersburg; UDC 535.2]

[FBIS Abstract] The generalized first-order partial differential equation of quasi-optics for the amplitude E of

the electric field of a light wave, for an amplitude which varies slowly relative to the wavelength of light and to period of optical oscillation, describes coherent radiation in optical media with or without  $f(E) = \operatorname{Re} f + j\operatorname{Im} f$  nonlinearity. The coordinate along which the amplitude E changes can be the longitudinal one in the preferred direction of propagation of a monochromatic light beam or the longitudinal coordinate associated with an optical pulse which propagates at some group velocity. It can also be the time coordinate in a longitudinally averaged description of wide-aperture nonlinear optical systems. For an analysis of solitons, their properties and interactions, polarization effects are ignored and the electric field intensity then treated as a scalar quantity. The results of a theoretical study are reported concerning the properties and interactions of solitons in three classes of nonlinear optical systems homogeneous in both space and space-time, of particular interest being nonlinearity with saturation of the two-level model kind. Class I includes passive (without external pumping) transparent media of any of  $d=1,2,3$  geometrical dimensionality and with zero  $\operatorname{Im} f$  where radiation beams or pulses propagate. Class II includes passive (without external pumping) transparent media of any of  $d=1,2,3$  geometrical dimensionality and with nonzero  $\operatorname{Im} f$  where amplification and absorption saturate. Class III includes also active systems with external pumping such as wide-aperture lasers of any of  $d=1,2$  geometrical dimensionality, with nonzero  $\operatorname{Im} f$  and with absorption saturation. Class III includes externally radiation-pumped systems such as wide-band nonlinear interferometers of any of  $d=1,2$  geometrical dimensionality. Project R53000 partially financed by the International Science Foundation. References 14.

### Pseudodeep Hologram With Real Physical Recording Depth

957A0389B St. Petersburg OPTIKA I  
SPEKTROSKOPIYA in Russian Vol 78 No 1, Jan 95  
(manuscript received 1 Aug 94) pp 133-135

[Article by Yu.N. Denisyuk, N.M. Ganzherli, S.Ya. Gorelik, and S.A. Pisarevskiy, Institute of Engineering Physics imeni A.F. Ioffe, St.Petersburg; UDC 535.317.1]

[FBIS Abstract] Recording deep 3-D holograms in layers of light-sensitive materials much thicker than the space period of the imprinted standing wave by the method of pseudodeep holograms makes it possible to utilize the advantages of such holograms and at the same time avoid certain technological difficulties. A pseudodeep hologram is essentially a plain 2-D hologram inserted into an optical which contains two lenses and performing Fourier transformations. A linear object and the reference source are placed on a horizontal line perpendicular to the plane of the pattern, in the leading focal plane of the first lens. The aperture stop then narrows the recording beam. Reconstruction is done by sources located on the same line, with the horizontal slit in the trailing focal plane of the second lens. The main drawback of such a system is a low diffraction efficiency when

it operates in the pattern recognition mode or in the associative information retrieval mode. When a large light source is used for reconstruction in those cases, then in addition to light beams analogous to those reconstructed by a 3-D hologram the pseudodeep hologram reconstructs also many intermodulation components which are then clipped by the aperture stop. One possible way to reduce the number of those components is to supplement the pseudodepth with the real physical recording depth. Undesirable deflection of light beams at the layer boundary is prevented by placing the layer between two right-angle glass prisms and closing the two gaps with an immersion fluid such as glycerin. An experiment was performed with a 20  $\mu\text{m}$  thick Dupont grade HRF-20 photopolymer film sensitive to 628 nm He-Ne laser light and first oriented perpendicularly to the optical axis. Inclining it at an 18° angle increased the path of light beams three times as much upon addition of an immersion fluid than without one. This in turn

increased the angular selectivity of the hologram so that a grating was recorded in the film: a grating formed by interference of two plane waves propagating horizontally at a 20° angle between them. Limiting the angular selectivity of gratings recorded in the hologram limits their ability to interact with particles of a large reconstructing light source so that there will fewer intermodulation components and the diffraction efficiency of the reconstructed image will be much higher. Supplementing the pseudodepth with the real physical recording depth has a similar effect on the diffraction efficiency of the pseudodeep hologram. The results of measurements made with a 441.6 nm He-Cd laser on a Dupont grade Omnidex 352 photopolymer film confirm that as the intensity of exposure is being increased, the diffraction efficiency will first increase to a maximum and then, after decreasing to a minimum, will again increase but to a lower second maximum. Figures 3; references 7.

**S&T Telecommunications Networks to be Self-Financed**

957A04224 Moscow POISK in Russian  
No 9, 4-10 Mar 95 p 1

[Article by Maksim Isayev]

[FBIS Translated Text] Russian science and education are serviced by several national telecommunication networks. A considerable part of the corresponding expenditures is covered by sums from the federal budget. A mechanism is possibly now being triggered which will put scientific telecommunications on the rails to self-financing. Reference is to the new Nauka [Science] data transmission telecommunication system (DTS). It is planned that it be established through the joint efforts of the Ministry of Science and Technical Policy (Minnauka), State Committee of Higher Education, Russian Fund for Fundamental Research, Ministry of Communications and Moscow State University. This was discussed at the last Minnauka collegium.

The Nauka data transmission system is based on different principles than the "national" networks now in existence. According to Nikolay Gusev, deputy head of the Division of Information Systems and Instrument Making of Minnauka, the idea of establishing such a network was first advanced in 1993. Even then some institutes had actively developed their own telecommunications. This process had gone most successfully at the Kurchatov Institute, the Institute of Theoretical and Experimental Physics and the Nuclear Physics Institute of Moscow State University. Things also had gone fairly well at the Space Research Institute, ensuring direct communication with NASA. The science centers in the Moscow region and St. Petersburg, Siberia and the Far East had acquired the necessary equipment and in places had even established local networks with interconnection to world networks, including Internet. For example, the Moscow State University teleport ensures a connection with Germany and St. Petersburg is joined by a fiber optic cable with Helsinki. Internet also is being used by individual institutes: it was found that it was considerably easier to interconnect with it than to link up with the unified Russian network. And, indeed, it is quite costly to make constant use of the ROSNET, RELCOM and ROSPAK commercial networks.

So the concept arose of a national scientific network which would operate in the interests of noncommercial organizations supported from the budget and which to a considerable degree could support itself. Not one of the presently existing networks operates on this principle, so that most of the institutions in the scientific and educational sphere, due to their poverty, have restricted access not so much due to technical barriers as due to material considerations.

The organization of the new network will make it possible to solve many problems. For example, two institutes standing side by side need not communicate with one

another, for example, via any foreign communication centers. And, in general, our science will feel itself free in the new information space. And not so restricted by costs. To be sure, for each institute connected to the network the volume of transmitted information will be limited. But within the framework of this limit, governed by the economic possibilities of the system, the users will feel themselves free because the network is being established primarily in their interests. In fact, the Nauka DTS will support itself: the equipment will be used by regional networks and organizations not funded under the budget. The transmission of information will not be inexpensive and it will be possible to earn money which will make it possible to pay off the costs involved in organizing local information input points. Incidentally, the access nodes will be located in large cities: Moscow, St. Petersburg, Novosibirsk, Khabarovsk, Yekaterinburg.

The Ministry of Science and Technical Policy, making use of already established local networks, in a few years intends to establish the entire necessary infrastructure. However, it will not be easy to do this, despite the fact that fiber optic communication channels are not called for in this structure. As a POISK correspondent was told by Vyacheslav Biryukov, chief specialist of the Division of Information Services and Instrument Making, such work in establishing networks is not a real responsibility of Minnauka: it involves direct investments in the infrastructure of science, which assumes the organization of a special subdivision in the Ministry. For the time being this task is being performed in the Division of Information Services and Instrument Making, in which only twelve persons work. Naturally, they are simply in no position to service the established telecommunication network and at the same time still perform their immediate obligations in coordinating scientific projects. So that as soon as the Minnauka decides to take this burden on itself it will have to have to hire other network operation specialists.

According to the most modest estimates, even the initial expenditures will be 25 million dollars. However, it is still premature even to speak of this sum because the problem of funding of the program has still not been solved. At the Minnauka collegium the principles for organizing the Nauka DTS were finally defined, but it is still necessary to prepare a systematic proposal stipulating all the nuances of operation of this telecommunication system. For the time being it is clear that the Nauka DTS will be coded in the TCP/IP protocols of the Internet network. The rate of data transmission between control points will be 2 Mbit/s.

Well, the solution of the full range of problems related to the funding, form of ownership and conditions for access to this system will take time and cost money. After all, the Minnauka is establishing a sort of analogue of a departmental network for scientific and higher education organizations, but with open access, as already stated, on completely different organizational-economic principles. And creating anything new always costs plenty...

**Plan to Recycle Nuclear-Powered Ship Components Described**

*957A0390A Moscow INZHENER in Russian  
No. 9, Sep 94 p. 26*

[Article by I. Shilenkov]

[FBIS Translated Text]

**Protection of the Environment**

**Scientists Promise Technological Breakthrough in Recycling of Nuclear Wastes**

A comprehensive waste recycling program has been developed for salvage of nuclear ships and submarines past their useful life.

A preliminary agreement has already been reached with several foreign banks and corporations regarding the \$1 billion technical credit they are about to extend. The credit will be made available as soon as the program officially acquires the status of a federal one. According to one of its developers, specialist Aleksandr Bavykin at the Military Naval Engineering Academy, this program is the result of a joint effort by many Institutes and enterprises working with the Ministry of Atomic Energy, the Ministry of Defense, the State Commission on Defense Matters, and other establishments. One of them, the Moscow Joint Stock Company EKO-BIO will henceforth act as the financial coordinator of that program (the terms of the credit stipulated by the foreign financial houses are not made public).

The total number of nuclear ships and submarines past their useful life now already exceeds 150 and will reach about 200 by the year 2000. The recycling technologies available today make it possible to treat only one or two such vessel a year so that the salvaging process could last a whole century. Besides, a great many reactors in nuclear power plants need to be replaced and their depleted parts to be fast and effectively recycled. To the list one may add nuclear icebreakers and particularly the "Lenin" with the high level of background radioactivity in its individual components, which renders it unsuitable at this time to even serve as a museum.

The program is designed to do the job in 10-15 years. In addition to introduction of new recycling technologies for the salvage of radioactive ship and submarine components, the program is to include decontamination and thus conservation of parts made of unique special-purpose steel (grades AKA-25, 27, 29) produced only in Russia and nowhere else but in the world. Resmelting this steel into gray iron, as is the usual practice, would be a senseless exercise in squander. On the other hand, the "cryogenic embrittlement" technology developed at the Russian Science Center "Applied Chemistry" jointly with the St.Petersburg Technological Institute of the Refrigeration Industry facilitates recovery of structural parts for reuse. After the core has been emptied and the rocket engine shaft as well as the reactor been cut out, the

skeleton structure (3-4 thousand tons left of a modern vessel) is being cooled with methane. While it combines with air, this gas explodes and breaks the structure but at the seams only. This technology, unlike conventional hot cutting, keeps parts of the hull intact. Today it takes two months to cut one submarine to pieces, while with the new technology this will be accomplished in one week.

There also has been found an effective way to remove a radioactive film (tenths of a millimeter thick) from the surface of a submarine or its mechanisms: they, too, will not have be stored in the "burial site." There is now being developed a remote treatment of vessels with a high level of background radioactivity, that is of the over 300 depleted nuclear power plant reactors and 5 submarines which must not be approached on account of that hazard. Although the program is basically designed for recycling and salvage of equipment ensuring navigability of the fleet, the technologies can also be used for the solution of analogous problems in nuclear power plants. One example is partial recovery of nuclear fuel and its subsequent use, another example is use of nuclear power plants on transport and naval vessels as power generators (especially in the Northern region). Competent recycling of vessels can be an effective way to return scrapped ferrous, nonferrous, precious, and semiprecious metals into the national economy.

One part of the program will be development of a health protection system for personnel engaged in deactivation work. Under consideration is use of new antioncotics and radiation shielding devices for protection against radiation and its effects. Substantial financial support has been earmarked for the St.Petersburg firm "Fitolon," which is now working on several projects. The program includes, moreover, quarantine ["social shielding"] of personnel engaged in deactivation work.

Upon appropriation of the funds, it will already very soon be possible to proceed from experimentation on industrial mockups to work on actual vessels. According to the chief engineer Nail Burangulov at the St.Petersburg Center of Strategic Research, Western countries (above all the United States) are most anxiously interested in completion of this project. Russia has developed unique technologies for deactivation and reprocessing of materials from nuclear objects. Specialists figure that they will be quite able to reduce by one order of magnitude the cost of carrying out such work. Negotiations with American representatives are already in progress regarding establishment of an International Center which will subsidize these activities. Japan, England, and France have already indicated an interest in participation.

As the project is being successfully carried out, Russia will be able to enhance its revenue substantially by licensing its know-how to other countries. It will also be able to eliminate the huge expenditures on mandatory maintenance of registered nuclear ships now afloat (operating one vessel is estimated to cost approximately 1 billion rubles annually). The program should also include relieving currently overfilled storage sites of excessive radioactive waste by way of its more compact burial.

**Analysis of Cellular and Humoral Mechanisms of the Antiradiation Effect of the Preparation NS-1539**

957C0060A Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA in Russian No 3, Jul-Sep 94 [manuscript submitted 28 Feb 94] pp 20-22

[Article by V.G. Lebedev, T.V. Vorotnikova, Yu.B. Deshevoy, Institute of Biophysics, Ministry of Health and Medical Industry of Russia, Moscow; UDC 615.849.2.015.25].015.44.07]

[FBIS Abstract] Estrogen injected in experimental animals has been found to protect against ionizing radiation. Since, for various reasons, the classical representative of the synthetic estrogens, diethylstilbestrol, cannot be used for such purposes, the researchers here chose to study the nonsteroid NS-1539, an analog of tamoxifen—specifically, they examined the effect produced by NS-1539 on the content and proliferative activity of early hemopoietic precursor cells (CFU<sub>s</sub> and CFU-GM), the number of morphologically identifiable bone-marrow and peripheral-blood elements, and the blood levels of GM-CSF in F<sub>1</sub>(CBA x C57B1) mice at various intervals after the injection of the preparation, before irradiation. The researchers also studied the post-irradiation recovery of hemopoiesis in the mice. It was found that the radio resistance produced by the preparation stems largely from the effects it produces on the content and functional activity of CFU<sub>s</sub> and CFU-GM. Bone-marrow levels drop, and proliferative activity is hindered—both of which trigger the hemopoietic regulatory system. GM-CSF levels rise for a lengthy period, maintaining radio resistance in a manner similar to that of growth-differentiation factors. Figures 1, references 15: 9 Russian, 6 Western.

**Protective Effect of  $\beta$ -1,3-Carboxymethylglucan Fraction in Acute Massive Blood Loss**

957C0060B Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA in Russian No 3, Jul-Sep 94 [manuscript submitted 7 May 91] pp 33-35

[Article by Ye.I. Vereshchagin, T.A. Korolenko, Y. Shandula, Institute of Physiology, Siberian Department, Russian Academy of Medical Sciences, Novosibirsk; Chemical Institute, Slovakian Academy of Sciences, Bratislava; UDC 616-005.1-036.11-02:615.275.4]

[FBIS Abstract] Stimulation of mononuclear phagocytes after blood loss produces a relatively rapid recovery of baseline erythrocyte levels. There has been little study, however, of the effect of mononuclear phagocytes on recovery of adequate hemodynamics and gas exchange

or on the protection of tissue from hypoxia in massive blood loss. Although preparations that stimulate mononuclear phagocytes and are suitable for clinical use have been developed on the basis of  $\beta$ -1,3-glucan, the action varies not only according to fraction, but also according to derivative. The researchers here set out to study the effects produced on CBA mice by two fractions of  $\beta$ -with different molecular weights and solubilities and found that the fraction with a molecular weight of greater than  $10^6$  (sparingly soluble), when administered 24 hours before the blood loss, resulted in a rapid recovery of the volume of circulating blood and in redox and blood-gas-composition indices. It also protected the tissues against injury. The fraction with a molecular weight of less than  $1.2 \times 10^5$  demonstrated a capability for actually slowing the recovery period. Figures 3, references 12: 3 Russian, 9 Western.

**Comparative Efficacy of the Peptide Preparations Finoptin, Levamisole, and Prednisolone in Experimental Immune Cardiogenic Shock**

957C0060C Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA in Russian No 3, Jul-Sep 94 [manuscript submitted 13 Nov 91] pp 35-37

[Article by T.I. Grekova, V.A. Shaydarova, L.A. Kireyeva, Department of Faculty Therapy, Central Scientific Research Laboratory, Voronezh Medical Institute imeni N. N. Burdenko; UDC 616.12-001.36-092: 612.017.1]-85-036.8-07]

[FBIS Abstract] Although dalargin, a stable analog of leu-enkephalin, has been shown to have cardioprotective properties in experimental myocardial ischemia, as well as in stress and adrenal damage of the heart muscle, and the delta-sleep peptide has demonstrated an antistress effect, enhancement of extracardial parasympathetic effects on the heart, a higher threshold of ventricular fibrillation, and longer survival rates for animals in immobilization stress, those peptides have seldom been the focus of study in immune damage of the myocardium. Glucocorticoids, levamisole, and thymus preparations are generally used in the clinic for immune damage, and researchers have found that calcium antagonists have the ability to suppress certain components of the immune response. In light of that, the researchers here chose to compare the efficacy of new peptide preparations and calcium antagonists with the efficacy of the drugs generally used in immune damage of the myocardium. They found that, in a model of immune cardiogenic shock in 104 outbred mice, finoptin demonstrated protective properties comparable to prednisolone. Dalargin, delta-sleep peptide, levamisole, and T-activin decreased the animals' life spans and/or increased their mortality rate. References 13: 8 Russian, 5 Western.

**Use of Chitosan-Based Liquid Sorbents for Treatment of Diffuse Peritonitis**

957C0060D Moscow PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTALNAYA TERAPIYA in Russian No 3, Jul-Sep 94 [manuscript submitted 2 Jul 91] pp 49-50

[Article by I.N. Bolshakov, S.M. Nasibov, D.V. Kulayev, Yu.M. Lopukhin, Scientific Research Institute of Physicochemical Medicine, Ministry of Health of the Russian Federation, Moscow; UDC 616.381-002.1-08-036.8]

[FBIS Abstract] The endogenous intoxication associated with peritonitis stems largely from the release and adhesion of bacterial lipopolysaccharide (LPS) on cells and tissues. In recent years, a search has been under way for affine ligands to bacterial LPS that are efficacious, but are relatively benign in living systems. Chitosan—a deacetylation of chitin—is biologically active and has low toxicity, and its use as a vehicle for the immobilization of polymyxin B sulfate has made it possible to produce a sorbent that demonstrates high antitoxic activity. Polymyxin B, as a surface-active polypeptide, has a high affinity to LPS and forms a sturdy complex with it, one that, when bound covalently on an agarose matrix, is used in immunochemistry to produce high titers of anti-LPS antibodies. The researchers here tested the detoxifying properties of a liquid sorbent based on chitosan with 9 mg/ml covalently immobilized polymyxin B. The sorbent demonstrated detoxifying action upon lavage of infected abdominal cavities in Wistar rats. The detoxifying action was attributed to recovery of baseline levels of direct bilirubin, cholesterol and triglycerides, as well as a fourfold reduction in uric acid levels and a 4.5-fold enhancement of hepatic AST and alkaline phosphatase. References 10: 1 Russian, 9 Western.

**On Introducing Changes in and Supplements to Terms of Wages of Public Health Workers (Order No 28 Dated 17 February 1994)**

957C0088A Moscow VRACH in Russian No 8, Aug 94 pp 2-3

[On Introducing Changes in and Supplements to Terms of Wages of Public Health Workers (Order No 28 Dated 17 February 1994)]

[FBIS Translated Text] In accordance with decree No 785 dated 14 October 1992 of the Council of Ministers-Government of the Russian Federation "On Differentiation in Terms of Wages of Budget Sphere Workers on the Basis of a Uniform Wage Scale"

**I APPROVE:**

1. In agreement with the Russian Federation Ministry of Labor (decree No 188 dated 30 December 1993) the changes in and supplements to wage categories on the basis of a uniform wage scale and wage rates and skills descriptions concerning positions of public health workers in the Russian Federation approved by order No 55 dated 30 March 1993 of the RF Ministry of

Health Care [in accordance with the president's edict No 66 dated 10 January 1994 the Ministry of Health Care was renamed the Ministry of Health Care and the Medical Industry] (Appendix 1).

2. The supplements to and changes in the "Appendix on Wages of Public Health Workers in the Russian Federation" approved by order No 301 dated 23 November 1992 of the RF Ministry of Health Care (Appendix 2).
3. In agreement with the Central Committee of the Trade Union of Public Health Workers in the Russian Federation the changes in and supplements to the "List of Institutions, Subdivisions, and Positions, Work in Which Gives Workers the Right to an Increase in Salaries (Rates) in Connection With Health Hazards and Especially Difficult Working Conditions" (Appendix 3).

**I ORDER:**

1. Ministers of health care of republics within the Russian Federation and directors of main administrations, administrations, divisions, departments, and committees of public health, of Moscow's Main Medical Administration, and of institutions and organizations of republic subordination to accept the changes in and supplements to terms of wages of public health workers approved by this order for guidance and execution.

2. This order shall be put into effect as of 1 January 1994.

[Signed] Minister E.A. Nechayev

**Appendix 1 to Order No 28 Dated 17 February 1994 of the RF Ministry of Health Care and the Medical Industry**

**Changes in and Supplements to Wage Categories on the Basis of a Uniform Wage Scale and Wages and Skills Descriptions Concerning Positions of Public Health Workers in the Russian Federation Approved by Order No 55 Dated 30 March 1993 of the RF Ministry of Health Care**

**(Appendix to Decree No 188 Dated 30 December 1993 of the RF Ministry of Labor)**

1. In Appendix No 1 "Wage Categories on the Basis of a Uniform Wage Scale Concerning Positions of Public Health Workers in the Russian Federation" to the decree changes shall be introduced in the range of categories of the positions "dental technician," "laboratory worker," "x-ray technician," "instructor in exercise therapy," "instructor-disinfectant," and "medical statistician" and set forth in the following version:

<b>Titles of Positions</b>	<b>Range of Categories</b>
Dental technician	6-10
Laboratory worker	6-10
X-ray technician	6-10
Instructor in exercise therapy	6-10
Instructor-disinfectant	6-10
Medical statistician	5-9

2. In Appendix No 2 "Wage Rates and Skills Descriptions Concerning Positions of Public Health Workers in the Russian Federation" to the decree supplements and changes shall be introduced in the sections "Skill Requirements With Respect to Wage Categories" concerning the positions "nurse," "dental technician," "laboratory worker," "x-ray technician," "instructor in exercise therapy," "instructor-disinfector," and "medical statistician" and set forth in the following version:

**Nurse (Categories 6-11)**

Skill requirements with respect to wage categories. Secondary medical education in the specialty "nursing":

categories 6-7—nurse not having a skill category;

categories 7-8—nurse having skill category II;

categories 8-9—nurse having skill category I; nurses not having a skill category: scrub nurse, anesthetist, ward nurse, nurse in charge of medical procedures, nurse in charge of massage, and general practitioners;

categories 9-10—nurse having the highest skill category; nurses having skill category II: scrub nurse, anesthetist, ward nurse, nurse in charge of medical procedures, nurse in charge of massage, and general practitioners;

category 10—nurses having skill category I: scrub nurse, anesthetist, ward nurse, nurse in charge of medical procedures, nurse in charge of massage, and general practitioners;

category 11—nurses having the highest skill category: scrub nurse, anesthetist, ward nurse, nurse in charge of medical procedures, nurse in charge of massage, and general practitioners.

**Dental Technician (Categories 6-10)**

Skill requirements with respect to wage categories. Secondary medical education in the specialty "orthopedic stomatology":

categories 6-7—dental technician having skill category III;

categories 7-8—dental technician having skill category II;

categories 8-9—dental technician having skill category I;

categories 9-10—dental technician having the highest skill category.

**Laboratory Worker (Categories 6-10)**

Skill requirements with respect to wage categories. Secondary medical education in the specialty "laboratory work":

categories 6-7—laboratory worker not having a skill category;

categories 7-8—laboratory worker having skill category II;

categories 8-9—laboratory worker having skill category I;

categories 9-10—laboratory worker having the highest skill category;

**X-Ray Technician (Categories 6-10)**

Skill requirements with respect to wage categories. Secondary medical education:

categories 6-7—x-ray technician not having a skill category;

categories 7-8—x-ray technician having skill category II;

categories 8-9—x-ray technician having skill category I;

categories 9-10—x-ray technician having the highest skill category.

**Instructor in Exercise Therapy (Categories 6-10)**

Skill requirements with respect to wage categories. Secondary medical or physical culture education:

categories 6-7—instructor in exercise therapy not having a skill category;

categories 7-8—instructor in exercise therapy having skill category II;

categories 8-9—instructor in exercise therapy having skill category I;

categories 9-10—instructor in exercise therapy having the highest skill category.

**Instructor-Disinfector (Categories 6-10)**

Skill requirements with respect to wage categories. Secondary medical education and special courses in the training of instructors-disinfectors:

categories 6-7—instructor-disinfector not having a skill category;

categories 7-8—instructor-disinfector having skill category I;

categories 9-10—instructor-disinfector having the highest skill category.

**Medical Statistician (Categories 5-9)**

Skill requirements with respect to wage categories. Secondary medical education:

categories 5-6—medical statistician not having a skill category;

categories 6-7—medical statistician having skill category II;

categories 7-8—medical statistician having skill category I;

categories 8-9—medical statistician having the highest skill category.

**Appendix 2 to Order No 28 Dated 17 February 1994 of the RF Ministry of Health Care and the Medical Industry****Supplement to the Statute on Wages of Public Health Workers in the Russian Federation Approved by Order No 301 Dated 23 November 1993 of the RF Ministry of Health Care (Appendix 2)**

1. Point 6.1.6. shall be set forth in the following version:

6.1.6. Allowances in amounts corresponding to the length of continuous work in traveling brigades shall be reserved to physicians of traveling brigades of first-aid stations (departments), who assumed the positions of chief first-aid physician, his deputy, and heads of departments and first-aid substations, as well as to workers among medium-level medical personnel of traveling brigades of first-aid stations (departments), who assumed the positions of doctor's assistant (nurse) for the acceptance of calls and their transmission to traveling brigades, or of senior doctor's assistant at a first-aid substation.

2. Subpoint 6.2.1.2. shall be set forth in the following version:

6.2.1.2. To workers specified in points 6.1.2.-6.1.5. of the Statute—the time of continuous work, including at more than one job, in these institutions, subdivisions, and positions, as well as the time of work in antileprotic and other institutions (structural subdivisions), which are engaged in the control of especially dangerous infections, to the workers of which the payment of an allowance for the length of continuous work is made.

**Appendix 3 to Order No 28 Dated 17 February 1994 of the RF Ministry of Health Care and the Medical Industry****Changes in and Supplements to the "List of Institutions, Subdivisions, and Positions, Work in Which Gives Workers the Right to an Increase in Salaries (Rates) in Connection With Health Hazardous and Especially Difficult Working Conditions"****(Appendix 2 to the Statute on Wages of Public Health Workers in the Russian Federation Approved by Order No 301 Dated 23 November 1992 of the RF Ministry of Health Care)**

1. In section I "Public Health Institutions" of the List:

1.1. Subpoint 1.15 shall be set forth in the following version:

1.15. Laboratories, divisions, and departments during work with live pathogens of infectious diseases (or sick animals), with disease causing viruses, with aggressive media and chemical reagents, on the investigation of potentially infected materials

(biological liquids and tissues), and on microscopes and polariscopes with the use of toxic immersion liquids and immersion objectives.

1.2. Subpoint 2.15. shall be set forth in the following version:

2.15. Antituberculosis dispensaries, sanatoriums, and departments (of hospitals, dispensaries, and clinics) for the treatment of pulmonary patients and tuberculosis departments and offices for servicing territorial districts.

2. In section II "Institutions of Education and Social Protection for the Population."

2.1. The remark for subpoint 1.6. shall be supplemented with the words: "Medical and labor examination commissions of general specialization and course bases for teaching disabled persons to drive motor vehicles."

2.2. Point 2 shall be supplemented with subpoint 2.8:

"2.8. Specialized medical and labor examination commissions for tuberculosis patients	Positions of physicians and of medium-level and junior medical personnel of all types provided for servicing pulmonary tuberculosis patients."
---	--

**Central and Peripheral Effect of Delta Sleep Inducing Peptide on Cardiac Electric Stability**

95A0022A Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received 9 Nov 93) pp 566-568

[Article by M.I. Arkhangelskaya, Experimental Cardiology Laboratory, Normal Physiology Scientific Research Institute imeni P. K. Anokhin, Russian Academy of Medical Sciences; UDC 612.172.4:577.152: [612.81+612.82]

[FBIS Abstract] Acute experiments were carried out with 28 male rabbits under Nembutal narcosis to ascertain the central and peripheral effects of a sleep-inducing peptide on cardiac electric stability with the injection of the peptide in a dose 10 µg in 20 µl of physiological solution in the lateral right or left cerebral ventricle. Some animals were first subjected to a bilateral vagotomy prior to injecting the peptide in order to study the role of the vagus nerves in transmitting central influences to the heart. The peptide inducing delta sleep (DSIP) results in an increase in the threshold of appearance of fibrillation of the cardiac ventricles with both intravenous and direct administration, but with the following differences. The DSIP effect with its systemic administration already develops during the first 10-20 minutes and persists during the entire observation period. With central administration its effect is observed later, attaining reliable changes only at the end of the

first hour. This indicates that the increase in the fibrillation threshold during the first 30-40 minutes of DSIP action detected in systemic but absent in the central administration method was caused by its peripheral action. Thus, with the central method for the injection of peptide the electric stability of the heart also increases, although with a lag of about 60 minutes. This effect may be attributable to the central action of the DSIP, operative through extracardial regulation. A bilateral vagotomy did not change the effects of the DSIP on electric stability of the heart when it is injected into the lateral cerebral ventricles. Figure 1; references 17: 8 Russian, 9 Western.

**Influence of Narcosis on Effect of Acute Experimental Poisoning of Animals by Pesticide Antio ("Sandoz") From Group of Organophosphorus Compounds**

957A0022B Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received 29 Dec 93) pp 587-590

[Article by I.A. Tarakanov, Ya.K. Kurambayev and V.A. Safonov, General Pathology and Pathophysiology Scientific Research Institute, Russian Academy of Medical Sciences; UDC 615.285.7.099].015.2.076.7]

[FBIS Abstract] In an earlier study animals under Nembutal narcosis were poisoned with the organophosphorus compound Antio ("Sandoz") and virtually all quickly died. This seemed contrary to expectations and therefore using adult cats of both sexes a study was made of the principal parameters of respiration and systemic blood circulation by per os administration of the same dose of Antio to wakeful (under weak ether narcosis) animals. Under these same conditions a study was made of the effect of atropine usually used in poisonings with cholinesterase blockers. The effect of activation of the GABA-ergic system, closely related to the cholinergic system, also was determined. The pesticide was introduced through a catheter into the stomach in a quantity 20 percent of the LD<sub>50</sub>. After several days the animals were intraperitoneally administered sodium pentobarbital (40 mg/kg). It was found that narcosis exerts a strong influence on the resistance of animals to poisoning by organophosphorus compounds (OPC), weakens the compensatory-adaptive reaction and possibly synergically with the OPC favors impairment of tissue respiration. One to three days after the intake of Antio there was a decrease in the PaO<sub>2</sub> in the arterial blood and a quickening of cardiac and respiratory rhythms, although arterial pressure under these conditions had a well-expressed tendency to a decrease. After intoxication the animals exhibited a restructuring of autonomic regulation of functions expressed in a sharp decrease in the parasympathetic influence. Figure 1; references: 16 Russian.

**Research on Apathogenic Strains of *F. tularensis*, *B. abortus* and *Y. pseudotuberculosis* as Producers of Recombinant  $\beta$ -Endorphin**

957A0022C Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received 6 Dec 93) pp 612-615

[Article by V.M. Borzenkov, A.P. Pomerantsev, O.M. Pomerantseva and I.P. Ashmarin, Department of Human and Animal Physiology, Biology Faculty, Moscow State University imeni M. V. Lomonosov; Applied Microbiology Scientific Research Institute, Obolensk, Moscow Oblast; UDC 615.371: 579.841.95.012.6.07]

[FBIS Abstract] In an earlier study by the authors (BYUL. EKSPER. BIOL., No 8, pp 153-153) it was found that the regulatory peptide  $\beta$  endorphin has important effects on mice, depending on the dynamics of multiplication in them of a strain of the tularemia microbe generating recombinant  $\beta$  endorphin. An effort was therefore made to achieve a still stronger effect of recombinant  $\beta$ -endorphin by creating a number of strains capable of more intensive and prolonged synthesis of the peptide in vitro and in the organism of a vaccinated animal. The strains *Y. pseudotuberculosis*, *B. abortus* and *F. tularensis* producing recombinant  $\beta$ -endorphin were obtained. All these microorganisms are capable of prolonged survival in the bodies of laboratory animals. The maximum production of recombinant  $\beta$ -endorphin was registered in the cells of the *V. pseudotuberculosis* microbe, the level of whose production exceeded by a factor of 6 the values obtained for *B. abortus* and *F. tularensis*. The peptide synthesized by cells of the *V. pseudotuberculosis* microbe had a well-expressed physiological effect and cells of the strain 2243 (pSK95E) persisted up to 6 days in the rat body and retained a capacity for synthesizing  $\beta$ -endorphin regardless of the times of segregation of the culture. The strain *Y. pseudotuberculosis* 2243 (pSK95E) was selected for further study of the influence of the additively synthesized peptide on the physiological state of the organisms carrying this strain. Figures 2; references 15: 9 Russian, 6 Western.

**Obtaining Monoclonal Antibodies to O-Antigen of *Salmonella Typhimurium* Serum Group B (0-4.5)**

957A0022D Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received 18 Jan 94) pp 630-632

[Article by M.V. Rayevskaya, N.V. Kovalchuk and Yu.A. Belya, Department of Cell Physiology and Immunology, Biology Faculty, Moscow State University imeni M. V. Lomonosov; Epidemiology and Microbiology Scientific Research Institute imeni N. F. Gameli, Russian Academy of Medical Sciences; UDC 615.371:579.842.14].012]

[FBIS Abstract] Although the quantitative ratio of species and strains of salmonella present in the environment has recently been changing, *S. typhimurium* as before

occupies first place, dictating further research on protection against it. Five BALB/c mice, 6 to 10 weeks old, were intraperitoneally immunized with thermally killed *S. typhimurium* bacteria. Immunization took place three times with a 1-month interval. Animals whose sera yielded the maximum titer of antibodies in immunoenzyme analysis were used for hybridization. The spleen was extracted under aseptic conditions. For obtaining antibodies in high concentrations the hybrid cells were cultivated in vivo in the form of an ascitic tumor. Sixteen clones secreting mouse monoclonal antibodies with different specificity to salmonella antigens were obtained. One of the clones manifests a high specificity to the O-antigen of *Salmonella typhimurium* (serum group B) when using the immunoenzyme analysis method. The antibodies which were obtained constitute immunoglobulins of class IgG2a; the light chain is of the kappa type. The binding epitope is a trisaccharide series. The antibodies are bound with whole cells of *S. typhimurium* bacteria and do not have cross-reactivity with a representative of the family of enterobacteria *E. coli*. The described antibodies are recommended for further use in studying the antigen structure and as a basis for developing a differential diagnosis of salmonella. Figures 3; references 13: 9 Russian, 4 Western.

#### **Obtaining and Describing Mice Monoclonal Antibodies to K-Antigen of *Salmonella Typhimurium***

*957A0022E Moscow BYULLETEM EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 117 No 6, Jun 94 (manuscript received 25 Jan 94) pp 633-635*

[Article by M.V. Rayevskaya, Yu.A. Belya, N.V. Kovalchuk, L.N. Chernousova and V.G. Petrukhin, Department of Cell Physiology and Immunology, Biology Faculty, Moscow State University imeni M. V. Lomonosov; Epidemiology and Microbiology Scientific Research Institute imeni N. F. Gameli, Russian Academy of Medical Sciences; Tuberculosis Institute, Moscow; UDC 615.371:579.842.14].012]

[FBIS Abstract] The K-antigen of salmonella is a surface-somatic thermolabile phosphoryl-glycoprotein present in all bacteria of the genus *Salmonella* and its concentration correlates with the degree of virulence of the strains. Monoclonal antibodies (MCA) to the K-antigen of *S. typhimurium*, which constitute immunoglobulins of the class IgC1, were obtained and described for the first time; the light chain is of the kappa type. The method for obtaining the MCA is described in detail. Five BALB/c mice, ages 6 to 10 weeks, were intraperitoneally immunized with thermally killed *S. typhimurium* bacteria. Immunization was at 1-month intervals. Three days prior to hybridization there was a intravenous booster immunization of 100  $\mu$ g of the K-antigen in a phosphate-salt solution. Animals whose sera yielded the maximum

titre of antibodies in immunoenzyme analysis were used for hybridization. For obtaining antibodies in high concentrations the hybrid cells were cultivated in vivo in the form of an ascitic tumor. The MCA exhibit a high activity in indirect immunoenzyme analysis with purified K-antigen and intact fixed cells of *S. typhimurium* and have virtually no cross-reactivity with the O-antigen of bacteria of this same species and with antigen structures of *E. coli*. A study was made of the kinetics of binding and the capacity for agglutinating intact bacterial cells and an epitope analysis was made which showed that the antigen determinants of the K-antigen of *S. typhimurium* qualitatively differ from those of the O-antigen for bacteria of the same species. Figures 3; references 10: 9 Russian, 1 Western.

#### **Microbiologic Criteria for Evaluating Ecologic Risk**

*957A0022F Moscow BYULLETEM EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 117 No 6, Jun 94 (manuscript received 25 Oct 93) pp 636-638*

[Article by V.Yu. Sokolov, Orenburg Section on Persistence of Microorganisms, Ecology and Genetics of Microorganisms Institute, Ural Department, Russian Academy of Sciences; UDC 577.4:576.809.3:576.809.7]

[FBIS Abstract] The various factors involved in the infectious process are reviewed. It is felt that much can be contributed to the evaluation of ecologic risk by studying children, the group most sensitive to environmental factors and the most uniform in its makeup (age, absence of professional hazards and harmful personal habits). Accordingly, the composition of the microflora of the nasal mucosa was determined in the child population of four ecologically contrasting regions (those with relatively high and relatively low incidence of respiratory disease) over the course of five years (1987-1991) in order to formulate criteria for a microbiologic evaluation of ecologic risk. Two hundred school children (ages 8-12) were studied in each region. Taxonomic criteria: with an increase in ecologic risk among the staphylococcus carriers there is an increase in the percentage of carriers of the coagulopositive staphylococci strains (more than 50 percent of the total number) and at the same time there is a sharp increase in the percent of carriers of saprophytic spore-bearing bacilliform flora (40 percent or more). Immunological criteria: among the staphylococcus carriers there is a predominance of carriers of genetically active microorganisms with a high antihistonic level (more than 50 percent of the total number). In ecologically unfavorable regions there was a predominance of strains of *St. aureus* with antihistonic activity and carriers of spore-bearing bacilliform flora. Taking these considerations into account it seems that the development and use of this microbiologic approach for early diagnosis and prophylaxis of ecologic risk is promising. References 6: 4 Russian, 2 Western.

### Antiopsonic Effect of Extracellular Products of Staphylococci

957A0022G Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received  
26 Dec 93) pp 639-641

[Article by O.V. Bukharin, D.G. Deryabin and Yu.A. Brudastov, Orenburg Section on Persistence of Microorganisms, Ecology and Genetics of Microorganisms Institute, Ural Department, Russian Academy of Sciences; UDC 576.851.252:576.8.097.5]

[FBIS Abstract] An important role in ensuring prolonged survival of microorganisms in the infectious process is played by their capacity to suppress the mechanisms of natural resistance of the host organism. For representatives of the genus *Staphylococcus* this effect can be attained by impairment of opsonic cooperation, resulting in a decrease in the intensity of interaction between a phagocyte and a bacterial cell. A study was made of the mechanisms of protection of staphylococci against the opsonizing action of the blood serum, imparted through their extracellular products: anticomplementary factor and protein A. Experiments were carried out using the chemiluminescence of macrophages method. For representatives of the *Staphylococcus aureus* type it was found that there is a capacity for inhibition of the opsonic effect of immunoglobulins and the C3 component of the complement associated with the presence of the mentioned extracellular products. An independent and reliable determination of the antiopsonic effect of the extracellular products of staphylococci was established on the basis of definite criteria. The results make it possible on a new basis to evaluate the phenomenon of formation of a protein cover on the surface of a bacterial cell with its penetration into the internal medium of the microorganism. The mechanism of an antiopsonic effect was interpreted in detail for representatives of the species *S. aureus*. The detected impairments in phagocytic response also are the probable pathogenetic link in the persistence of staphylococci. Figure 1; references 12: 9 Russian, 3 Western.

### Stem Blood-Forming Cells With Introduced Foreign Gene—Proliferative Activity and Potential at Remote Times After Transplantation to Irradiated Mice

957A0022H Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received  
24 Nov 93) pp 648-650

[Article by I.L. Chertkov, N.I. Drize, O.I. Gan, N.I. Olovnikova, Ye.V. Belkina and T.L. Nikolayeva, Hematological Science Center, Russian Academy of Medical Sciences; UDC 612.419]

[FBIS Abstract] There has never been a detailed comparison of such fundamental properties of stem blood-forming cells as development potential, proliferative potential and activity of their descendants in tagged cells in comparison with normal cells. A study was therefore made of proliferative potential and activity of stem blood-forming cells in mice restored by bone marrow into which the human ADA gene had been transduced. A method was developed for transfer of genes without use of cytokin prestimulation and a study was made of the possible influence of prestimulation by exogenous cytokins on the properties of stem-forming cells at remote times after transplantation. The transfer of the ADA human gene into the stem blood-forming cells of mice was accomplished by the ordinary method of retroviral transduction with use of cytokins and also using stimulation of stem blood-forming cells without cytokins on an irradiated substrate of a bone marrow culture. The study was made using BDF1 mice 1-16 weeks old. Only male mice were bone marrow donors and only females were recipients. The mice were irradiated in a dose 12 Gy. The efficacy of gene transfer into colony-forming units by means of cytokins was 72 percent, without them—50 percent. The irradiated mice restored by tagged bone marrow maintained donor blood formation for a period of 1 year. A table gives information on lethally irradiated mice functionally restored by different quantities of bone marrow cells under two different transduction protocols. The proliferative activity of the colony-forming units of the chimeras 6 months after restoration was identical regardless of the gene transfer method, but spleen repopulating activity was reduced in all groups of chimeras 6-12 months after restoration. Figures 2; references 7: 2 Russian, 5 Western.

### Impact of Low-Intensity Luminescent Radiation on Regeneration Processes in Skin Wounds of Rats

957A0022I Moscow BYULLEHEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received  
9 Nov 93) pp 665-667

[Article by V.A. Monich, B.Ye. Shakhov and A.V. Vorobyev, Nizhegorod Medical Institute; UDC 612.014.44]

[FBIS Abstract] Sources of low-intensity luminescent monochromatized incoherent radiation (LMIR) (using encased two-layer optical fibers) were used in treating surgical wounds in the soft tissues of rats. The fiber optic system provided three different light ranges (red, spectral maximum 635 nm; orange, spectral maximum 605 nm; green, spectral maximum 540 nm). Details are given concerning the structure and composition of the employed optical fiber. Exposures began the day following the surgical incisions. The 5-cm wounds had sutures 1 cm apart; the wounds were first treated with a

5 percent iodine solution. Radiation was directed to the wound region through a lightguide 0.8 mm in diameter; exposure time was 15 minutes; radiation density was 20 mW/cm<sup>2</sup>. This therapy continued for 5 days. There were three groups of animals with 10 rats in each group, subjected to different loads. A fourth group was the control, subjected to a lesser load. In four series of experiments a search was made for the influence of the duration of the irradiation series on the recovery of a postoperative wound. The day-to-day changes in the wound area are described. It was found that in such soft-tissue wounds exposure of the wound to low-intensity luminescent incoherent radiation causes an acceleration of regeneration processes. An influence on these processes is exerted by the frequency of the light bursts and the spectral composition of the luminescent radiation. References 10: 9 Russian, 1 Western.

#### **Research on Transcription of Cerebral Cortex Neurons of Rats Under Homo- and Heterotopic Transplantation Conditions at Different Times of Postnatal Ontogenesis**

957A0022J Moscow BYULLESEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received 29 Dec 93) pp 667-669

[Article by O. V. Bulchuk, A. V. Grigoryeva and V. N. Yarygin, Russian State Medical University; UDC 519.881-95-923.4:612.018-393]

[FBIS Abstract] Research was carried out for quantitative evaluation of the principal parameters of vital functioning of a neuron and the changes of these parameters under transplantation conditions. A study was made of the level of matrix activity of nuclear chromatin of large and medium pyramidal and stellate neurons of the third, fourth and fifth layers of the somatosensory cortex of the cerebrum or cerebellum of rats under normal conditions and during the course of differentiation (on the 14th, 45th and 90th days of postnatal ontogenesis) under transplantation conditions. The donor material was nerve tissue from the cerebral cortex of 19-day old embryos. The animals with transplants were sacrificed on the 17th, 48th and 93d days and transcription chromatin activity was quantitatively estimated for each of these groups by the radioautographic method, making it possible to detect the activity of endogenous RNA polymerases in fixed cells. In the case of homotopic transplantation the mean level of matrix activity of exonucleolar chromatin of different neuronal populations did not attain the maximum level of the norm at any of the investigated times. In the case of heterotrophic transplantation, on the other hand, the mean transcription indices in almost all the investigated cases reliably exceeded the control level. Figures 2; references 3: 2 Russian, 1 Western.

#### **Influence of Monochromatic Light of Red and Near-IR Spectral Regions on Adhesive Properties of Cell Membrane: Dependence on Wavelength**

957A0022K Moscow BYULLESEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 117 No 6, Jun 94 (manuscript received 15 Nov 93) pp 670-672

[Article by T.Y. Karu, L.V. Pyatibrat and R.O. Yesenaliyev, Industrial Lasers Science Research Center, Russian Academy of Sciences; Spectroscopy Institute, Russian Academy of Sciences, Troitsk, Moscow Oblast; UDC 377.391.621.375.8]

[FBIS Abstract] The optimum wavelength for therapeutic laser apparatus has not yet been determined. In seeking a solution of this problem the authors in an earlier study (BYUL. EKSPER. BIOL., Vol 65, No 6, pp 622-623, 1993) found that after irradiation by light with  $\lambda = 632.8$  nm the adhesive properties of HeLa cells change as a function of time after irradiation. Continuing this research, an effort was made to find the dependence of the change in adhesive properties of a cell membrane on the wavelength used for irradiation. The number of attached cells was used in determining the change in the adhesive properties of the cell membrane after irradiation of a suspension of HeLa cells by monochromatic visible and near-IR radiation ( $\lambda = 580-860$  nm,  $i = 1.3$  W/m<sup>2</sup>,  $t = 40$  s,  $D = 52$  J/m<sup>2</sup>). Three spectral ranges were detected (600-625 nm, 645-700 nm, 720-860 nm) with maxima near the wavelengths 620, 680, 750 and 825 nm at which an intensification of the adhesive properties of the cell membrane is observed. As the optimum wavelength for laser therapy of small groups of patients it is possible to propose the wavelength range 820-830 nm or 750-760 nm. Light at these wavelengths penetrates deeper into the tissue than does light at 680 and 620 nm. Figures 2; references 9: 4 Russian, 5 Western.

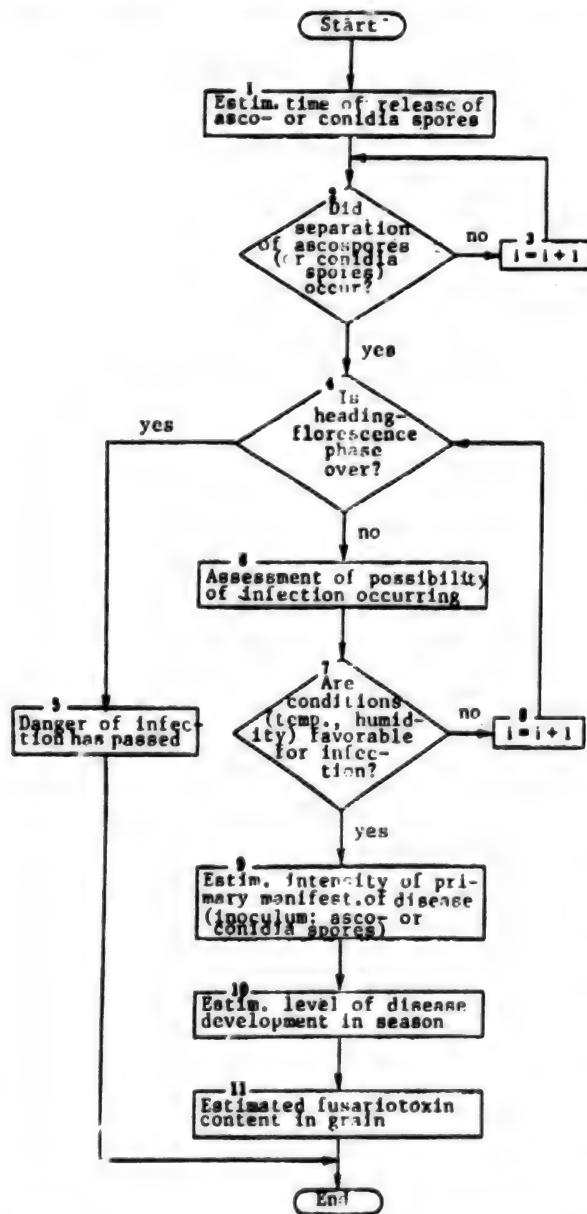
#### **Forecasting Possibility of Primary Manifestation of Spike Fusariosis (Pathogen Fusarium graminearum)**

957A0107A Moscow DOKLADY ROSSIYSKOY AKADEMII SELSKOKHOZYASTVENNYKH NAUK  
in Russian No 6, Nov-Dec 94 (manuscript received 20 May 93) pp 24-26

[Article by V.I. Terekhov, N.I. Fissura, V.I. Bessmeltsev, N.G. Poliyevets, and M.N. Isayeva (submitted by V.A. Zakharenko, academician of the Russian Agricultural Academy); first paragraph is DOKLADY ROSSIYSKOY AKADEMII SELSKOKHOZYASTVENNYKH NAUK introduction; UDC 631.544]

[FBIS Translated Text] Models are shown for assessing possible infection of grain crops with *Fusarium graminearum* macroconidia and intensity of manifestation of disease as a function of density of deposition of macroconidia and ecological resources at the time of infection. The intensity of primary manifestation of disease was proportionate to density of deposition of inoculum and ecological resources.

Control of the pathogen in order to take protective steps should be based on quantitative evaluation of the different stages of pathogenesis (Figure 1). The proposed flowchart reflects only part of the tasks that we plan to carry out on the problem of "fusariosis and fusariotoxins."



**Figure 1. Flowchart of "Main stages of pathogenesis of disease." Operators 3 and 8 symbolize the transition to observations after 24 h**

We describe here models to forecast the possibility of macroconidial infection and intensity of primary manifestation of disease as a function of density of deposition

of *F. graminearum* macroconidia and ecological resources at the time of infection.

There are different views on evaluating the role of the complete and incomplete stages of the pathogen of fusariosis of grain crops in forming the primary potential of the inoculum. In particular, priority is attributed to the complete stage in [1, 2], and in [3] it is attributed to the incomplete one. It can be asserted that absolutization of the significance of one stage or the other at the start of an epiphytic outbreak does not explain all situations under real conditions.

Conceptually, both models are parametrically linked. Indeed, an infectious process occurs only if there is moisture in droplet form (rain, dew, drizzle), and with a favorable combination of temperature and duration of wetting. Consequently the ecological resource with regard to the pathogen can be characterized as a dyad of the above parameters. If we assume that all other factors of the infectious process (susceptible phase in host plant, inoculum, and others) are not limited, the ecological potential of the infectious process can be defined with the formula:

$$i = f_1(t)f_2(T), \quad (1)$$

where  $i$  is value of ecopotential,  $f_1(t)$  and  $f_2(T)$  are functions of temperature and duration of humid period, respectively.

The choice of  $f_1(t)$  can be explained as follows. There is a certain minimum temperature at which infection is impossible, even if there is the longest period of humidity. It is also apparent that infection is also impossible at very high temperatures (when protein denaturation occurs). For this reason, a third indicator is added, the optimum temperature. With reference to choice of function  $f_2(T)$ , there is a certain minimal period of humidity when, after it reaches a certain maximum value, there is no further increment of ecological potential.

With consideration of the foregoing, equation (1) can be written down as follows

$$i = \exp[-\alpha_1(t - t_{opt})^2] \left[ \frac{1}{1 + \exp(\alpha_2 - \alpha_3 T)} \alpha_4 \right] \cdot \varepsilon, \\ t_{min} < t < t_{max} \quad (2)$$

where  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ , and  $\alpha_4$  are constants that can be defined from experimental data;  $\varepsilon$  is a minor parameter that converts  $i$  to zero with critical values for  $t$  and  $T$ .

Of course, it is necessary to consider density of deposition of inoculum settling on the surface of the spike to assess primary manifestation of disease. It is known that the spores of parasitic fungi can affect one another during sprouting, eliciting slowing or stimulation of

growth. Equation (3) generally defines the effect of density of macroconidial deposition on intensity of primary manifestation of disease:

$$f_3(P) = \exp \left[ -\alpha_5 \left( 1 + \frac{\alpha_4}{\lg(p+1) - \alpha_7} \right)^2 \right], \quad (3)$$

where  $\alpha_5$ ,  $\alpha_6$ , and  $\alpha_7$  are coefficients of proportionality,  $P$  is number of macroconidia settling on crops,  $M^{-1}$ .

Consequently, primary manifestation of disease ( $Y_0$ ) will be proportionate to  $i$  and  $f_3(P)$ :

$$Y_0 = i f_3(P). \quad (4)$$

The model for assessing the possibility of occurrence of an infectious process is parametrically linked to the model of primary manifestation of disease as a function of ecological resources. We determine the function that separates ecoresources into favorable and unfavorable zones for spike infection from the condition:

$$t_i(t) \left( \frac{1}{1 + \exp(\alpha_2 - \alpha_3 T)} - \alpha_4 \right) - \varepsilon = 0, \quad (5)$$

Then

$$T = \frac{\alpha_2 - \ln \left( \frac{1}{t_i(t)} - 1 \right)}{\alpha_3}, \quad (6)$$

$t_{min} < t < t_{max}$ .

Figure 2 illustrates the model graphically. The equation for the discrimination curve separates plane  $T$ - $t$  into zones of possible (+) and impossible (-) infection. If the actual humid period will be longer or equal to the one calculated using formula (6) at a set temperature, the crops will be infected (provided the inoculum is viable and the plant is at the susceptible phase). Otherwise no infection will occur.

These views in considering the two models are confirmed by experimental studies carried out under controlled conditions (Tables 1 and 2), on the basis of which the values of empirical coefficients were estimated (Table 3). Figure 3 illustrates the correlation plot of calculated and actual values for primary manifestation of spike fusariosis. The results of comparing actual and calculated values ( $r^2 = 0.9$ ) are indicative of the validity of the model described.

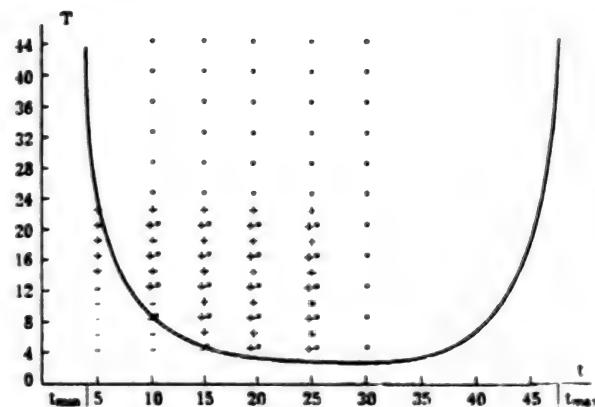


Figure 2. Possibility of infection of wheat crops by the pathogen of spike fusariosis as a function of duration of humidity ( $T$ ) and air temperature ( $t$ ) during the period of infection; + and \* refer to 1991 and 1992 series, respectively.

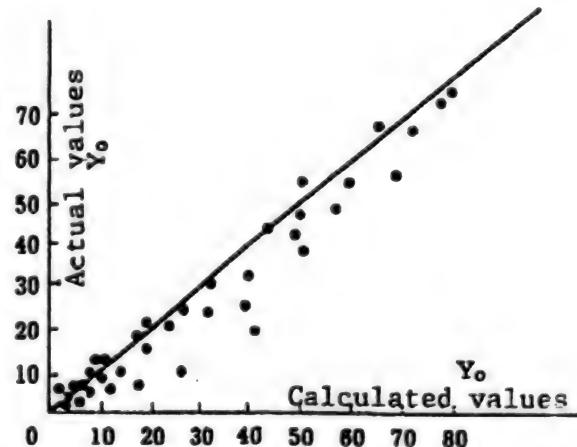


Figure 3. Correlation plot of calculated and actual values for intensity of primary manifestation of disease  $Y_0$ .

**Table 1. Intensity of primary manifestation of spike fusariosis (percentage) as a function of ambient temperature and duration of humid period (1992, density of inoculum deposition  $6 \times 10^7$  conidia/m<sup>2</sup>)**

Duration of wetting, h	Temperature, °C ??				
	10	15	20	25	30
4	0.1	1.2	2.1	3.3	2.7
8	1.6	1.8	3.5	12.5	13.1
12	3.5	2.1	4.5	15.4	15.5
16	4.4	4.2	4.7	22.2	19.3
20	4.6	4.4	9.6	32.2	32.5
24	4.7	6.1	14.0	38.0	40.2
28	5.8	6.6	21.6	42.2	43.2
32	6.3	7.9	21.7	47.5	55.3
36	5.3	15.3	23.2	51.4	54.2
40	5.5	16.6	26.1	65.6	66.7
44	5.9	19.4	46.4	76.4	67.5

**Table 2. Intensity of primary manifestation of spike fusariosis as a function of density of deposition of pathogen inoculum**

Inoculum density, conidia/m <sup>2</sup>	Development of disease, %
$5.0 \times 10^3$	9.7
$1.5 \times 10^4$	5.7
$5.0 \times 10^4$	13.7
$1.5 \times 10^5$	10.5
$5.0 \times 10^5$	35.0
$5.0 \times 10^6$	38.0
$1.5 \times 10^7$	20.0

Note: Plants were infected at ambient temperature of 20-25°C and with 44 h watering.

**Table 3. Model coefficients for calculation of intensity of primary manifestation of spike fusariosis**

$a_1$	$a_2$	$a_3$	$a_4$	$a_5$	$a_6$	$a_7$	$\epsilon$	$t_{opt}$	$t_{min}$	$t_{max}$
0.013	2.88	0.12	2.26	6.53	1.47	0.0715	0.0027	26°	4.8	47.2

Thus, we have offered a mathematical model of intensity of primary manifestation of disease, which has two ecological parameters (ambient temperature and duration of humid period at time of infection), and density of deposition of inoculum, as well as a model for evaluating conditions for possible infection by macroconidia. It is assumed that they will be included in the system of forecasting development of spike fusariosis.

#### References

- Ivashchenko, V.G., and Nazarovskaya, L.A., DOK-LADY VASKhNIL, 1990, No 12.
- Levitin, M.M., et al., MIKOLOGIYA I FITOATOLOGIYA, 1990, Vol 7, No 24.
- Lacicowa, B., "Fusarium: Mycotoxins, Taxon. and Pathogenicity, Semin. Warsaw, Sep 8-10, 1987," Amsterdam etc., 1989.

#### Mental and Vegetozomatic Disorders Due to Long-Term Exposure to Low Doses of Radiation

957A01134 Moscow ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA in Russian Vol 94 No 4, Jul-Aug 94 (manuscript received 10 Feb 94) pp 62-65

[Article by S.V. Golovenko, Vinnitsa Medical Institute imeni N. I. Pirogov; UDC 616.89+616.1/.8-06: 612.014.482]

[FBIS Translated Text] After the accident at the Chernobyl Nuclear Power Plant (CNPP), victims presented a wide diversity of pathological manifestations due to the nature of combined physical injury to the most vulnerable systems of the body. The different share of exogenous (radiation), somatic, psychogenic and personality components determines both the uniqueness of pathogenesis and diversity of clinical symptoms, first of all neuropsychiatric diseases. These circumstances and the

traditional subjectivity of psychiatric diagnosticians present some difficulties in identification and expert evaluation of neuropsychiatric and vegetosomatic disorders arising in individuals affected by the CNPP accident.

One can discuss the role of ionizing radiation in biological effects among individuals exposed to radiation only when the main methodological rules are followed to examine them and assess findings. It is important to mention the opinion held that most effects, particularly at the long term, are polyetiological and that it is necessary when studying them to take into consideration the links in complex systems of interaction with various factors, in particular radiation. While the pathogenic effect of high doses of radiation has been studied rather fully, the influence of low doses, let alone exposure to them for a long time, has been little studied. In recent years, there have been several works dealing with the adverse effect of low doses of radiation [1-3]. Variants of neuropsychiatric disorders and their psychopathological structure have been described. Along with neurotic disorders, somatophysical and somatic disturbances are noted [4-5]. However, these studies were carried out on random groups of patients and did not include data on group follow-up.

We examined a group of patients exposed at the same time to radiation during eradication of the sequelae of the CNPP accident in 1986, as well as individuals who have been permanent residents for seven years of territories contaminated by radioactive elements—strontium, cesium, and plutonium, as indicated by the documentation on radioactive contamination of the area. Moreover, we carried out dynamic observation of individuals residing in contaminated regions who had been examined in 1987 and in 1991-1992, which ruled out subjectivity of conclusions.

For a fuller assessment of the patients' condition we used different laboratory tests (EEG, REG, biochemical, and immunological tests), and performed a psychological examination. The somatic condition of the patients was evaluated by specialists. Such a comprehensive examination combined with clinical observation, study of both statics and dynamics of psychopathological disorders enables us to avoid a biased approach to assessment of neuropsychiatric disorders.

No doubt, there are patients with neurosis, with vegetative pathology, reactive depression, or pathological development among the victims. Obviously, today's economic crisis and difficult sociopsychological situation are instrumental in adding new psychogenic and neurotic "strata" in such patients, as well as reciprocal induction of patients, including income-related sets. Some scattered observations indicate that, under the influence of radiation, endogenous and endogenous-processual diseases undergo such a considerable pathomorphosis that it is difficult to separate such patients from the bulk of victims. However, the percentage of such diseases in the population of victims is so small that

it cannot affect the overall picture of symptomatology of diseases observed among individuals exposed to radiation.

Our study revealed that it is possible to identify neuropsychiatric and vegetosomatic disturbances of radiation genesis provided there is strict adherence to the syndromal approach to the problem and objectivization of symptoms by using all available test methods (biochemical, instrument, psychopathological, immunological, epidemiological).

In order to investigate the distinctive manifestations of neuropsychiatric and vegetosomatic disorders caused by exposure to so-called low doses of radiation, we placed under dynamic, nonrandom observation individuals hospitalized in the borderline pathology unit of Vinnitsa Oblast Psychiatric Hospital No 1 in 1987 and 1991-1992 who presented neurotic complaints; they were permanent residents of settlements in Vinnitsa Oblast, Ukraine, and had been exposed to radionuclide contamination as a result of the CNPP accident (confirmed by documentation on radiation in the area, provided by the Ukrainian Ministry of Health).

The subjects were divided into two groups. The first consisted of 182 people, and there was prevalence of individuals from the most contaminated regions among the hospitalized patients.

The second group consisted of 120 patients who had been directly involved in eradicating [referred to elsewhere as eradicators] the sequelae of the CNPP accident in 1987, had undergone examination at a hospital, and were treated in medical and neurological units of a hospital for the disabled.

The groups of patients were identical in educational, cultural and occupational levels, as well as sex, age and social standing.

Analysis of their histories and available medical records failed to reveal deviations in the premorbid period in one-third of the subjects; one-quarter of them presented elements of hypochondria and anxiety, and the rest—emotional instability. Prior to the CNPP accident, two-thirds of the subjects in the eradicator group and the group residing in contaminated regions considered themselves to be in good health.

The depression syndrome was found to be the most frequent finding in both groups, affecting 29 percent of the second group and 29.1 percent of the first; the asthenohypochondriac syndrome was also encountered at approximately the same frequency in the two groups, 27 and 28.6 percent, respectively. There was prevalence of the psychoorganic syndrome in the second group (27 percent), as compared to the first (8.2 percent), as well as of the obsessive-phobic syndrome (10 and 5.5 percent). These syndromes can be observed with exposure to virtually any dose of radiation although, of course, a high cumulative dose caused a more severe psychopathological syndrome; however, no direct correlation was demonstrated. The only exception was the psychoorganic

syndrome, which occurred with maximum doses of ionizing radiation. In the other cases, apparently premorbid personality features played the chief role, as confirmed by population follow-up findings and comparison of pathological manifestations among individuals who came from contaminated regions and were hospitalized in 1987 and 1991-1992.

The relatively circumscribed structure of the syndrome developed somewhat later. At the first stage, asthenic manifestations were the most prominent, and they were most marked among patients residing in contaminated regions. Several patients with asthenia developed indifference to everything, and they were concerned only with their own condition.

We must stress several psychopathological distinctions in the structure of syndromes. In most patients they were complex and polymorphic and, in addition to neurotic symptoms and psychoorganic disorders, there were pathocharacterological manifestations. Irritable weakness, manifested differently in different patients, was an asthenic symptom among patients treated in 1987. Thus, a number of patients presented heightened irritability in relation to both unusual and usual stimuli, and some of them had a paradoxical reaction: the weaker the stimulus, the more it disturbed them (a loudly spoken word could elicit such a violent reaction that the patient lost control of himself). Such emotional lability is apparently also the principal form of emotional-volitional instability, which subsequently characterized the psychoorganic syndrome.

At the same time, some asthenic patients became introverted, any unpleasantness prevented them from concentrating even more, they had thoughts about a lack of self-esteem, and anxiety about their future. They subsequently developed the depressive syndrome.

Headache was the second most frequent symptom of the asthenic syndrome. The patients complained of pressure in the head, related it to onset of fatigue, psychotrauma, and mental load. In many cases, headache as accompanied by vertigo or other vegetative disorders which subsequently served as the basis for development of the obsessive-phobic syndrome. Virtually all patients had a sleep disorder, and in 18 percent insomnia was so disturbing that it subsequently led to development of the depressive syndrome. In some patients insomnia became an obsessive idea: the patients fixed all their attention on it, believed it to be cause of lack of energy which, we are convinced, was the cause of development of the hypochondriac syndrome.

In addition, some patients presented cenestopathy in the form of the sensation of gooseflesh or burning in the limbs, facial region or head. Such disturbances were subsequently tracked in the structure of the depressive or hypochondriac syndrome. Some patients with the asthenic syndrome complained of unusual sensations in internal organs, pressure in the cardiac region, palpitations, asphyxia, pressure in the supraventricular region, and

bloated abdomen. These symptoms were the most prominent, relegating cardinal symptoms of classical asthenia to the background, and they were subsequently the basis for development of the hypochondriac syndrome.

Another important task we undertook was to find a link between the psychopathological syndrome, vegetosomatic disturbances and radiation dosage. In the vast majority of cases, in addition to mental disturbances, the patients presented various vegetosomatic disorders: cardiovascular, pathology of respiratory organs, gastrointestinal, immune systems, and others. There are grounds to believe that there is a direct correlation between vegetosomatic disturbances, radiation dosage and the main psychopathological syndrome, since computer processing of the data revealed that manifestation of some psychopathological, as well as vegetosomatic syndrome was a function of both the cumulative radiation dose and exposure separately to external and internal (as a result of incorporation of radionuclides) radiation.

In the presence of the psychoorganic syndrome, cardiovascular diseases prevailed in the second group with exposure to a cumulative dose of 5-10 mrem (42.42 percent), whereas in the second group [among people residing in contaminated regions] such a dosage of external radiation elicited disturbances in only 13.13 percent of the cases, while the other cases of cardiovascular pathology (33.33 percent) were due to the effects of incorporated radionuclides in a dosage of 10-15 mrem. With the depressive syndrome, there was prevalence of cardiovascular pathology in the second group (51.29 percent) also with a cumulative dose of 5-10 mrem, whereas external irradiation of resident patients in the same dosage elicited analogous disturbances in 16.98 percent of the cases, and maximum cases of pathology (22.64 percent) was noted with incorporated radiation in a dose of 10-15 mrem. The same pattern is demonstrable in individuals with the hypochondriac syndrome: cardiovascular disease prevailed with a dose load of 5-10 mrem (44.44 percent) in the second group, and in only 17.30 percent of the first group after exposure to external radiation; maximum number of cases of pathology (25 percent) was noted with incorporated radiation in a dosage of 10-15 mrem. With the obsessive-phobic syndrome, maximum frequency of cardiovascular pathology (58.33 percent) was noted in the second group after a cumulative radiation dose of 0-5 mrem; in the first group, cardiovascular disturbances were manifested at a frequency of 20 percent with 5-10 mrem external radiation; the figures for incorporated radiation were the same, 10 percent with a dosage of 10-15 and 15-20 mrem.

Respiratory organ disease in individuals with the psychoorganic syndrome prevailed (15.15 percent) after a cumulative radiation dose of 5-10 mrem; in the first group, this pathology prevailed (20 percent) with a dosage of 10-15 mrem incorporated radiation. In cases of the depressive syndrome, pulmonary pathology also prevailed (12.82 percent) with a cumulative radiation dose

of 5-10 mrem; in the first group, such pathology was also predominant (13.21 percent) with 5-10 mrem external radiation, whereas in the case of incorporated radionuclides the maximum number of cases of respiratory pathology (16.98 percent) occurred with a dose of 10-15 mrem. Analogous findings were made for the second group with the hypochondriac syndrome: pathology of the pulmonary system was predominant (13.89 percent) with a dose burden of 5-10 mrem; in the second group, we also observed prevalence of pulmonary pathology with 5-10 mrem external radiation, as well as 10-15 mrem (13.46 percent in both instances), whereas with incorporated radionuclides, such pathology was observed in 25 percent of the patients with a dosage of 10-15 mrem. The obsessive-phobic syndrome was combined with pulmonary pathology as follows: it was predominant in the second group with radiation doses of 0-5 and 5-10 mrem (16.76 percent for each), and in the first group the maximum number of cases of pulmonary pathology constituted 20 percent with 5-10 mrem external radiation, and 30 percent with 10-15 mrem from incorporated radionuclides.

Gastrointestinal pathology was predominant (18.18 percent) in the second group after a cumulative radiation dose of 5-10 mrem in the presence of the organic psychopathological syndrome; in the first group, such pathology prevailed (13.33 percent) with 20-25 mrem external radiation, whereas its presence was predominant (26.67 percent) after incorporation of radionuclides in a dosage of 10-15 mrem. In the second group, in patients with the depressive syndrome, the frequency of gastrointestinal pathology constituted 23.07 percent with a cumulative radiation dose of 5-10 mrem; in the first group, the maximum number of cases of this somatic pathology (11.32 percent) was observed after 5-10 mrem of external radiation, whereas in the case of incorporated nuclides the maximum (18.87) was found with a radiation dose of 10-15 mrem. Among eradicators, gastrointestinal pathology was predominant (55.55 percent) with the hypochondriac psychopathological syndrome after a cumulative radiation dose of 5-10 mrem; among irradiated residents, external irradiation in the same dosage also caused prevalence of gastrointestinal pathology (17.31 percent); in the case of incorporated radionuclides, the maximum number of cases of this somatic pathology (21.15 percent) occurred with a radiation dose of 10-15 mrem. With the obsessive-phobic syndrome, the incidence of gastrointestinal diseases among eradicators was at a maximum (50 percent) with a cumulative dose of 0-5 mrem. In the irradiated population [main group], the incidence of gastrointestinal pathology with this psychopathological syndrome constituted 10 percent both with 5-10 mrem external radiation and 10-15 mrem from incorporated radionuclides.

Special mention should be made of the strong correlation between immunodeficiency and psychoorganic changes. The submitted data indicate that the correlation between the prime psychopathological syndrome and vegetosomatic disorders was not the same in the two groups. It was more marked and diverse in eradicators. Thus, the

coefficient of correlation for the latter between psychopathological syndromes and many vegetosomatic disorders was 2-3 times higher than in patients residing in contaminated regions. We were impressed by the high degree of correlation between cardiovascular pathology and all psychopathological syndromes among the eradicators: psychoorganic (42.2 percent), depressive (51.28 percent), asthenohypochondriac (44.44 percent). The latter can apparently be related to the stronger influence of radiation and psychogenic factors, since these patients were directly involved in eradicating the CNPP accident and lived in a contaminated region. In the first group, such a correlation was noted only in the presence of the psychoorganic syndrome (33.33 percent).

#### References

1. Aleksandrovskiy, Yu.A., Rumyantseva, G.M., Shchukin, V.P., and Yurov, V.V., ZHURN. NEVRO-PATOL. I PSIKHIATR., 1989, No 5, pp 111-117.
2. Kryzhanovskaya, L.A., "Chernobylskaya katastrofa i mediko-psikhologicheskaya reabilitatsiya postradavshikh" [The Chernobyl Disaster and Medical-Psychological Rehabilitation of Victims], Minsk, 1992, pp 50-52.
3. Napriyenko, A.S., and Loganovskiy, K.N., VRACH. DELO, 1992, No 6, pp 48-52.
4. Grigoryev, Yu.G., Popov, V.I., Shadirkin, A.V., et al., "Somaticheskiye effekty khronicheskogo oblucheniya" [Somatic Effects of Chronic Irradiation], Moscow, 1986.
5. Chuprikov, A.P., Kryzhanovskaya, L.A., Kazakova, S.Ye., and Dvorostyanoy, K.V., "Aktualnyye problemy likvidatsii meditsinskikh posledstviy avari na CHAES" [Pressing Problems of Eradication of Medical Sequelae of the Chernobyl Accident], Kiev, 1992, p 248.

Izdatelstvo "Meditina," 1994

#### Mental and Neurological Health of the Child Population in Some Parts of Ukraine After the Accident at the Chernobyl Nuclear Power Plant

957A0113B Moscow ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA in Russian  
Vol 94 No 4, Jul-Aug 94 (manuscript received 10 Feb 94)  
pp 65-67

[Article by V.S. Podkorytov, V.S. Filyk, L.N. Malyshko, M.K. Mishanova, and L.I. Bogach, Department of Child Neuropsychiatry (chief V.S. Podkorytov, doctor of medical sciences), Ukrainian Research Institute of Clinical and Experimental Neurology and Psychiatry, Ukrainian Ministry of Health, Kharkov; UDC 616.89-053.2-06: 613.648]

[FBIS Translated Text] In recent years, there has been a stable trend toward increase in incidence of borderline mental disease among children in the Ukraine, as in other CIS states [1, 2, 5, 10]. The poor ecological

situation in the nation due to the aggregate effect of a number of deleterious industrial, agricultural, living, military and other factors are believed to be the chief causes of this deterioration of mental and neurological health of children [6, 12]. Among such factors, acute and chronic exposure of inhabitants of some parts of Ukraine to ionizing radiation, related to the sequelae of the Chernobyl accident, occupies a special place.

It is known that official medical statistics, which are based on indicators of frequency of visits paid by the child population to medical institutions, reflects only indirectly the health status of children. Many parents do not consider mental deviations in their children to be pathological, or do not believe official medicine, or else they are indifferent in general to the health of their children. In many instances, they do seek the attention of medical specialists, which of course affects indicators of recorded mental and neurological morbidity among the child population. At the same time, according to data in the literature [3, 7-9], true mental and neurological morbidity among this group, as determined by epidemiological studies, is not infrequently 5-10 times higher than recorded indicators, and in its structure there is prevalence of instances of borderline neurological and mental disturbances that sometimes include different types of speech disorders, rather than severe, clinically marked nosological forms.

Investigation of true incidence and nosological structure in a specific locality and subsequent comparative analysis of consequences of exposure of children to the main factors specific to a given region are a mandatory prerequisite for setting up programs of sociomedical rehabilitation of children with mental and neurological diseases.

We examined a sample consisting of 470 school children 6-7 and 11-12 years of age (in 1st-2d and 5th-6th grades, respectively) from 3 schools in Korosten, Zhitomir Oblast (main group) in order to study the distinctions and structure of mental and neurological morbidity among children residing in parts of Ukraine contaminated by radionuclides. Among these children there were 258 girls and 212 boys. At the time of the study, density of radionuclide contamination of soil in this city and adjacent localities constituted a mean of 10 Ci/km<sup>2</sup>, and up to 300 Ci/km<sup>2</sup> in some areas. Mean gamma background was 45-60  $\mu$ R/h. A comprehensive study was made of the children's mental, neurological and logopedic status.

As a control, we carried out an analogous comprehensive study of 440 schoolchildren of the same age residing in the clean [without radiation] city of Chuguyev, Kharkov Oblast. The total population, main working and living conditions were comparable in the two cities studied, and the age and sex structure of the two groups of children was similar. The radiation factor in expressly these regions of Ukraine was the main parameter in selection of children for the study of mental and neurological health.

Analysis of data obtained from examination of children in Korosten revealed that only 20 percent could be considered mentally and neurologically healthy. In most children with detected pathology (56.4 percent), there were combined disturbances involving all three areas: mental, neurological, speech. In 43.6 percent of the children we found disturbances in two of these areas, neurological and mental, with intact speech, or mental and speech without significant changes in neurological status, and others. There was prevalence of boys (2:1) among the sick children.

In the structure of mental disorders, clinically marked manifestations of various sequelae of residual organic involvement of the CNS were observed the most often (48.9 percent). The cerebro-asthenic syndrome was in first place among clinical findings in 19.5 percent of the children, and specific sleep disorders (difficulty in falling asleep, waking up frequently, nocturnal fright, and others) in 12.5 percent. Nocturnal or diurnal enuresis was present in 6.4 percent of the children, retarded mental development in 5.7 percent, and obsessive tics in 3.8 percent. Neurasthenia was diagnosed in 3.6 percent of the children, obsessive neurosis in 0.8 percent, and hysterical neurosis in 2.6 percent. It should be noted that radiophobia was virtually absent from the clinical signs of psychogenic disease. Other mental disturbances were found relatively seldom in the examined children: psychopathies and psychopathoid syndromes were noted in 1.3 percent of the cases, oligophrenia in 1 percent, epilepsy in 0.4 percent, and schizophrenia in 0.2 percent.

There was prevalence of manifestations of the syndrome of spinal fluid hypertension in the structure of neurological disturbances (52.5 percent of those examined) and vegetovascular dystonia (21.8 percent). Signs of hydrocephalus was found in 8.5 percent of the cases, manifestations of the diencephalic syndrome in 3.8 percent, pathology of sight organs in 6.1 percent, and neurological disturbances of vertebrogenic genesis in 2.1 percent. There were various types of hyperkinesia in 1.7 percent of those examined, signs of microcephaly in 0.8 percent, low-grade encephalitis in 0.4 percent. Very often, 2-3 sets of neurological symptoms were found in the same patient. In the structure of speech disorders, there was prevalence of dyslalia (38.7 percent), general grade III underdevelopment of speech was found in 8.3 percent of the cases, stuttering in 7.3 percent, motor alalia in 2.3 percent, tachylalia in 1.7 percent, and dysarthria in 1 percent.

A comparative examination of children in the control group living in Chuguyev, Kharkov Oblast, was carried out in order to determine the role of the radiation factor in the genesis of psychoneurological and speech disorders in Korosten children. It was assumed that health should be substantially better in a clean region than a contaminated one. However, the findings did not confirm this assumption. Thus, only 22.5 percent (26 percent in Korosten) could be considered entirely healthy in the control group, including 48.6 percent (41.2 percent)

with regard to mental status, 28.8 percent (27.9 percent) for neurological and 40.7 percent (32.9 percent) for logopedic status. In general, the structure of mental, neurological and logopedic morbidity among these children was similar to that of children from Korosten. Borderline psychoneurological disorders were in first place, and not infrequently their incidence, severity and dynamics were worse than in the main group. In the control group of children, in the structure of mental disorders there was also manifestation of consequences of residual organic involvement of the brain (43.8 percent). Among the clinical signs of disease there was prevalence of the cerebro-asthenic syndrome in 18.8 percent of these children, specific sleep disorders in 9.5 percent, enuresis in 7.7 percent, obsessive tics in 4.2 percent, retarded mental development in 3.6 percent, neurasthenia in 2.1 percent, hysterical neurosis in 1.2 percent, 1.1 percent obsessive neurosis. At the same time, oligophrenia was found in 1.8 percent of these cases, epilepsy in 0.4 percent, psychopathies and psychopathoid syndromes in 0.4 percent.

In these children, as in the main group, the most frequent finding (56.8 percent) in the structure of neurological disorders was spinal fluid hypertension. There was prevalence of signs of hydrocephalus in 16.1 percent of the examined children, signs of vegetovascular dystonia in 11.8 percent, pathology of sight organs in 6.1 percent, neurological disturbances of vertebrogenic genesis in 5.7 percent, and hyperkinesia in 2.5 percent. Signs of the diencephalic syndrome were found in 1.3 percent. Microcephaly was observed in 0.23 percent of those examined, and low grade encephalitis in 0.23 percent. As a rule, the clinical signs of illness included 2-3 neurological syndromes, and their manifestations were more marked than in the main group of children.

In the structure of speech disorders, dyslalia was found in 45.6 percent, and 20.19 percent of these children had general level III underdevelopment of speech, stuttering was present in 16.14 percent, motor alalia in 4 percent, tachylalia in 2.8 percent, and dysarthria in 2.5 percent. It should be noted that, in these subjects, more marked as well as combined speech pathology were observed more often than in the main group. The incidence of some forms, in particular stuttering, not only failed to decline with age, on the contrary it increased. As in the main group, speech disorders were found more often in boys (3:1).

Thus, as shown by the results of our comparative study, the data characterizing mental and neurological health of the child population residing in a radionuclide contaminated region and in a clean part of Ukraine are rather comparable and similar. In both locations we found disturbances in the vast majority of the child population, although this had not been reflected in official medical statistics. Consequently, the radiation factor, the pathogenic effect on children is confirmed by many researchers [4, 11, 13], is not the only or chief cause of rise observed in Ukraine in children's mental and neurological morbidity, in particular

borderline neuropsychiatric disorders. Evidently, other adverse ecological factors also have a negative effect of child health. The extent of the negative sequelae of exposure to each of them, and distinctions of effects on a child of the most hazardous combinations thereof require special investigation. At the same time, the relatively milder course of borderline neuropsychiatric disorders and their lesser intensity among children in the region with radiation (Korosten) require more thorough investigation of the causes of this phenomenon. Our in-depth comparative analysis of living conditions of children from the two Ukrainian regions studied revealed that, unlike the city of Chuguyev, the children in Korosten have been regularly consuming ecologically pure vitamin-enriched food for the last 5-6 years. They were submitted to diagnostic examinations using more informative techniques, including use of imported equipment, and children in whom this resulted in detection of disturbances were treated using effective foreign drugs. The school year was curtailed for the children from radionuclide contaminated regions, they were submitted annually to "health improvement" measures at sanatoriums and resorts, including some abroad. All these measures, which are usually unavailable to children from clean regions of the country, had a beneficial effect on the mental and neurological health of children from contaminated regions. The combined beneficial effect of proper nutrition, regular health improving measures at sanatoriums and resorts, early detection and prompt highly effective treatment of children exposed to chronic irradiation could serve as a model for elaboration of the main directions of a program for sociomedical rehabilitation of children with mental, neurological and speech disorders.

#### References

1. Arbuzova, V.N., Tanigina, G.B., Proskurina, T.Yu., et al., "Z'Izd. nevropatologiv, psikiatriv na narkologiv URSSR, 8-y; Tez. dopovidey" [8th Congress of Neurologists, Psychiatrists and Drug Abuse Specialists; Summaries of Papers (in Ukrainian)], Kharkov, 1990, pp. 80-81.
2. Bazilenko, I.B., "Problemy sovershenstvovaniya meditsinskoy pomoshchi naseleniyu g. Leningrad" [Problems of Improving Medical Care for the Inhabitants of Leningrad], Leningrad, 1988, p 159.
3. Vayzman, N.P., "Nevrozy u detey i podrostkov" [Neuroses in Children and Adolescents], Moscow, 1986, pp 34-36.
4. Derzhitskiy, V.Ye., Anikin, V.I., Balakir, Ye.A., et al., "Symposium Chernobyl-Sasakava: Doklady" [Chernobyl-Sasakawa Symposium: Papers], Moscow, 1993, pp 23-43.
5. Isayev, D.N., "Nevrozy u detey i podrostkov," Moscow, 1986, pp 70-72.
6. Kovalev, V.V., "Psikhogigiena detey i podrostkov" [Child and Adolescent Psychohygiene], Moscow, 1985, pp 56-66.

7. Kozlovskaya, G.V., and Kremneva, L.F., "Epidemiologiya psikhicheskikh zabolevaniy u vzroslykh i detey: Nauch. obzor" [Epidemiology of Mental Illness in Adults and Children: Scientific Survey], Moscow, 1981.
8. Lebedev, M.A., "Incidence and Structure of Neurotic Disorders Among Adolescent Schoolchildren," author abstract of candidatorial dissertation in medical sciences, Moscow, 1983.
9. Petrakov, B.D., and Petrakova, L.D., "Psikhicheskoye zdravoye narodov mira v XX veke: Nauch. obzor" [Mental Health of People in the World in the 20th Century: Scientific Survey], Moscow, 1984.
10. Podkorytov, V.S., "Aktualnyye problemy epidemiologicheskikh issledovaniy v psikiatrii" [Pressing Problems of Epidemiological Studies in Psychiatry], Moscow, 1990, pp 41-42.
11. Sayko, A.S., Danilyuk, V.V., Stotskaya, L.P., and Sokolovskiy, I.N., "Simpozium Chernobyl-Sasakava: Dokaldy," Moscow, 1993, pp 75-90.
12. Seleznev, S.I., Kuznetsov, V.M., Palamarchuk, V.G., et al., "Klinichna, sotsialno-trudova reabilitatsiya v nevrologii, psikiatrii ta narkologii" [Clinical, Sociovocational Rehabilitation in Neurology, Psychiatry and Drug Abuse Science (in Ukrainian)], Kharkov, 1993, pp 150-151.
13. Shiuniti Yatasita, Hiroyuki Namba and Sigenobu Nagataki, "Pochemu stol bolshoye vnimaniye udeleyetsya vliyaniju radiatsii na shchitovidnuyu zhelezu" [Why so Much Attention is Devoted to the Effect of Radiation on the Thyroid], Moscow, 1993.

Izdatelstvo "Meditina," 1994

#### Mental Health of the People of the Russian Federation

957A0113C Moscow ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA in Russian Vol 94 No 4, Jul-Aug 94 (signed to press 17 Oct 94) pp 79-90

[Article<sup>1</sup> by RAMS Mental Health Research Center, under the rubric "Current Problems of Organization of Mental and Neurological Care; UDC 616.89: 313.13(470)]

[FBIS Translated Text] One of the main social assets of any state is the health of the people, the most important element of which is mental health that largely determines both physical and social well-being of people.

Scientific and technological progress, and related constant complication of man's living conditions make increasing demands of his mental activity and promote the problem of mental health and human behavior to one of the first places among the principal factors of the nation's economic potential and national security.

Mental health affects the intellectual potential of a nation, development of productive forces and manpower resources, defense capability, moral and ethical atmosphere in society as a whole, and in its different strata and groups.

Along with other factors, the intellectual potential of a nation determines the level of development of society and its social and economic achievements. It will acquire even greater importance in the future, since it is one of the main components of social and economic progress of any society. The intellectual potential of a nation is formed on the basis of mental development and mental health of each individual and, consequently, society as a whole. Here, indicators such as number of mentally retarded people who cannot participate in the building and creative process,<sup>2</sup> as well as the number of people with mental illness, are important.

Of course, the problem of mental health cannot be reduced solely to mental diseases proper. It includes all the mental deviations, including those related to defects in mental and physical developmental, upbringing, other biological and social factors. In recent times, factors causing stress and disorders (technical and natural disasters, social, military and other conflicts, financial difficulties related to general rise in cost of living) began to acquire much importance.

Mental health of the people has a direct effect on the economic status of society, determining development of productive forces and manpower resources. This is related, first of all, to the fact that primarily young people, making up most of the work force, are stricken with mental illness. Many of them are chronically ill and require constant care and supervision for their entire life (groups I and II disability). One should also bear in mind that, since the life expectancy of mental patients is analogous to that of the population as a whole, for many years they are cared for by the government and family. Before price restrictions were lifted it was estimated that upkeep and treatment of mental patients costs our society at least 4.6 billion rubles per year. In addition, 3.6 billion rubles are spent on indirect expenses related to the gross national income that mental patients fail to contribute to society. At present these figures should be increased 300-fold or more.

A low level of intellectual development limits appreciably the possibility of selecting military contingents, thus having a direct impact on defense capability of the nation. Suffice it to state that more than 20 percent of the individuals called up are deemed unfit for military service, and they are excused from recruitment due to mental illness or mental retardation. More than 60 percent of those demobilized from the ranks of the army for health reasons have mental disorders. At the same time, one cannot fail to take into consideration the fact that the specific distinctions of learning to use combat equipment (necessary level of engineering knowledge, speed of mental

reactions and actions, and others), demand greater responsibility and reliability in the behavior of military personnel. In this regard, scientific validation and forecasting of deviations in behavior and emotional reactions become one of the central problems in the study of human behavior under extreme conditions.

The influence of man's mental health on the moral-ethical atmosphere of society is due to the fact that mental patients make up a considerable part of individuals subject to antisocial forms of behavior—antisocial and criminal acts. Approximately 3 percent of such patients are a danger to society. Many other types of antisocial behavior can also be due to abnormal personality traits, mental disease or mental retardation.

This is why many developed countries devote so much attention to services dealing with maintaining the mental health of the people. Many countries and international organizations have declared that the period from 1990 to 2000 is the decade for the study of the brain and mental health. This means that this decade must advance under the sign of continued development of neurological sciences and biological psychiatry in order to determine the causes and mechanisms of onset of mental illness, as well as to develop new methods of treating mental disorders.

Development of new classes of psychotropic drugs was instrumental in progress of clinical and neurobiological studies, and increased dramatically the efficacy of patient treatment which, in turn, made it possible to reduce the number of hospitalized patients and lay the foundation for rehabilitation of mental patients and their adjustment to ordinary living and working conditions.

At the present time, rethinking of the main guidelines for organizing mental health services is near completion. It has become apparent that modern psychiatry requires more intensive development of extramural and other new forms of patient care, and adoption of more effective rehabilitation methods. Involvement of psychiatrists and psychologists in patient care in the general system of the primary medical service merits special attention, since virtually every fifth patients in general polyclinics requires their assistance. Considering these requirements, new forms of mental health services have already cropped up, which go beyond the framework of traditional specialized psychiatric institutions. It is a question of optimum integration of patients with society, which is consistent with the present trends in development of modern psychiatry in the direction of greater humanization.

It is quite obvious that the necessary changes in the area of mental health and psychiatry cannot take place without having society and our country's administration appreciate the importance of psychiatric problems to the present and future of Russia. The shortcomings of our psychiatry reflect flaws inherent in the nation's entire health care system. We are referring to the extremely unsatisfactory material and financial support, chronic

shortage of current drugs, inadequate level of professional training of personnel at many hospitals and clinics, and lack of a solid legislative and legal base for psychiatric activities and protection of the rights of the mentally ill.

We should also mention the extremely low level of society's knowledge about psychiatry and of the extent to which the public is informed about mental health, psychiatry and psychiatric help. Expressly this is rich soil for cultivation of certain stereotypes and myths about psychiatry and psychiatrists. Furthermore, people who are not sufficiently informed about mental diseases are afraid of psychiatry and often conceal mental disorders. This makes it difficult to establish the true number of patients and to plan development of appropriate psychiatric services.

It is impossible to solve problems pertaining to mental health, including questions of planning and organizing psychiatric care, without considering the effect of social, microsocial and biological factors, as well as without a broad view of mental health as a whole, since many of these problems are beyond the limits of medicine and closely linked to social aspects of life. We shall succeed in solving all these problems only if all social forces and the government will be involved in initiative to raise the level of the people's mental health.

In this article, we are submitting a survey and analysis of information pertaining to the mental health of the people of Russia and psychiatry in all aspects, from statistical data characterizing the number of patients and performance of psychiatric services to financial, scientific, and ethical problems, and recommendations for government and social agencies involved in solving the problems discussed.

The main sections of this report are:

1. Mental health status of the Russian people.
2. Consequences of mental illness.
3. Status of the psychiatric service.
4. Medical psychology, psychological care and availability of specialists.
5. Research in psychiatry.
6. Humanitarian problems of psychiatry.
7. Conclusion.
8. Recommendations.<sup>3</sup>

#### I. Mental Health of People of Russia

##### **Causes of Mental Illness and Sources of Mass Mental Traumatization of the People**

Onset of mental illness, as is the case for many other diseases of man, depends on interaction of internal and external factors (harmful environmental influences). The internal factors include, first of all, hereditary ones. Such

diseases as schizophrenia, manic-depressive psychosis, epilepsy, and others are hereditary to a significant extent. However, all distinctions of the human body (age-related, constitutional, physical reactivity and others) are also considered to be internal factors.

The spectrum of external factors that could lead to development of mental disorders is very broad. These factors are divided into biological and psychogenic ones. The biological ones include infections, diverse forms of intoxication (including alcohol), trauma, and others. In such cases, infectious, intoxicational and traumatic psychoses, other mental disorders, and dementia may develop. Psychogenic factors include various types of mental trauma, which could not only have an individual, personal effect (loss of close one, family and job conflicts and others), but also affect large groups of people. In the latter case, we are referring to mass psychotraumatization. Mental trauma may provoke development of borderline (mild) mental disorders, onset and exacerbation of psychosis.

The separation of causes of illness into internal and external is not absolute. Conditions in the external and internal environment could prevent onset of disease (even hereditary) or, on the contrary, cause it to develop, depending on concrete circumstances.

Diseases related to developmental disturbances of the brain are singled out as a separate group. Such disturbances could be due both to genetic causes and influence of the environment on the early stages of brain development (intrauterine or in infancy), in particular maternal exposure to various harmful factors during the gestation period and parturition (infection, intoxication including alcohol, as well as maternal trauma to the mother and birth trauma to the fetus). Developmental disturbances of the brain could be subsequently manifested by mental disorders varying in severity, ranging from mild behavioral abnormalities and retarded mental development (including borderline deviation from normal) to gross developmental defects and mental retardation.

Complex interactions between external and internal factors also emerge in combination with ecological deleterious factors that have acquired particularly great importance in recent times in a number of regions of our country.

Reactions to psychotraumatic factors depend not only severity of trauma proper (which is often combined—physical and psychogenic), but also on endogenous factors in the victims. We should mention, first of all, wars, international conflicts, natural disasters, accidents and catastrophes, as well as increase in social and economic tension in society, among the most frequent causes of mass mental traumatization. Both the usual and special forms of manifestation of mental disorders and psychological reactions are observed following such acute and chronic mental trauma.

Unfortunately, we have no data at the present time concerning the number of victims of mass mental

trauma in our country. But it can be estimated by analogy to relevant indicators for other countries. Thus, by analogy to indicators obtained in the United States, in a survey of veterans of the wars in Korea and Vietnam, it can be assumed that two-thirds of the Afghanistan veterans have varying degrees of mental disturbances. Among individuals who have been severely maimed as a result of various accidents and disasters, such psychiatric care, including psychosocial rehabilitation, is needed by 60-95 percent of such victims.

It must be noted that not only the individuals directly injured in some accident, but also groups of people related to them (witnesses to the incident, relatives of victims, rescuers and even personnel or hospitals and morgue to which victims were taken) are exposed to the psychotraumatic effect. In the case of mass psychotraumatic incidents, the number of people with mental disorders could exceed significantly the number of victims proper.

The nature of mental disturbances in people who have sustained severe mental trauma varies, ranging from mild and brief deviations of behavior to severe psychosis. It is important that such sequelae could be manifested not only right after the accident, but also many years later in the form of the post-traumatic stress syndrome, a serious chronic mental illness observed in 35-50 percent of all victims.

#### Incidence of Mental Illness

In assessing mental health of the people, both official statistics, i.e., record kept by various psychiatric institutions of individuals who sought assistance there, and data established by special epidemiological studies as to the number of individuals suffering from some mental disorder but who did not seek assistance, for different reasons, in institutions of the psychiatric service. In addition, one must also consider the population groups with different types of psychological problems who need psychiatric and psychological care.

The incidence indicators used in government statistics pertain to psychosis and dementia (schizophrenia, manic-depressive psychosis, senile dementia and others), so-called borderline disorders (neurosis, psychopathy, situational and stress disorders, as well as the mildest forms of arrested mental development), and mental retardation.<sup>4</sup>

Two main indicators are used: incidence of mental illness (or illness of the people), i.e., number of patients per 100,000 (or 1000) population, and morbidity, i.e., number of new cases per year, also calculated per 100,000 (or 1000) population.

The relevant indicators on incidence and morbidity are listed in Table I.

**Table 1. Incidence of Mental Disorders and Morbidity Indicators for Russia at the Beginning of 1992**

Group of mental diseases	Incidence		Morbidity	
	number of patients on clinical records at end of 1991		number of patients with newly established diagnosis placed on clinical records during the year	
	absolute	per 100,000	absolute	per 100,000
Psychoses and dementia states	980,339	660.9	44,538	30.0—
including: schizophrenia	570,698	384.8	18,346	12.4—
psychosis and senile dementia	80,416	54.2	9,173	6.2
Borderline (nonpsychotic) mental disorders	715,880	482.6	69,343	46.8
Mental retardation	785,890	529.8	37,720	25.4
Totals	2,482,109	1673.4	151,601	102.3

As of 1 January 1992, there were recorded 2,482,109 mental patients in the Russian Federation. Out of every 100 population, 16.7 people suffer from some mental disorder.

In 1991, 151,601 new cases placed under observation in neuropsychiatric clinics and other psychiatric institutions of Russia, i.e., 102.3 per 100,000 population, or approximately every thousandth inhabitant of Russia.

Up to 1985, there was a consistent rise in the number of patients seeking psychiatric assistance and on clinic records: from 895.4/100,000 in 1965 to 2026.1 in 1987. But beginning with 1988, there was a decline of this indicator to 1673.4 in 1991 (Table 2). This pattern is inherent in patients with all types of mental illness. The decrease in number of registered cases is by no means related to improvement of mental health of the people, and it merely reflects changes in the rules for keeping psychiatric records.

**Table 2. Dynamics of Indicators of Number of Patients on Clinical Records in Russia from 1965 to 1991**

Group of mental diseases	Year	Number of patients		Percentage of total number of cases
		absolute	per 100,000	
Mental disorders (total)	1965	1,138,901	895.4	100
	1970	1,727,241	1321.6	100
	1980	2,568,410	1847.3	100
	1985	2,871,675	1995.1	100
	1987	2,963,101	2026.1	100
	1988	2,776,201	1883.9	100
	1989	2,566,086	1733.4	100
	1990	2,549,083	1716.1	100
Psychoses (total)	1991	2,462,109	1673.4	100
	1965	568,361	446.8	49.9
	1970	680,881	521.0	39.4
	1980	989,291	711.5	38.5
	1985	1,072,120	744.8	37.3
	1987	1,098,082	749.7	37.0
	1988	1,284,656	871.6	38.1
	1989	1,027,745	694.9	40.0
Including schizophrenia	1990	997,211	671.3	39.1
	1991	980,339	660.9	39.5
Including schizophrenia	1965	197,668	155.4	17.3
	1970	313,368	239.8	18.1

**Table 2. Dynamics of Indicators of Number of Patients on Clinical Records in Russia from 1965 to 1991 (Continued)**

Group of mental diseases	Year	Number of patients		Percentage of total number of cases
		absolute	per 100,000	
	1980	506,127	364.0	19.7
	1985	580,708	403.4	20.2
	1987	604,626	413.2	20.4
	1988	596,120	404.5	21.4
	1989	581,841	393.0	22.7
	1990	577,524	388.8	22.7
	1991	570,698	384.8	23.0
Borderline (nonpsychotic) mental disorders	1965	383,156	301.1	33.6
	1970	650,910	498.0	37.7
	1980	902,715	649.3	35.1
	1985	1,010,530	702.1	35.2
	1987	1,028,348	702.7	34.7
	1988	892,996	605.9	32.2
	1989	817,260	552.0	31.8
	1990	754,080	507.7	29.6
	1991	715,880	482.6	28.8
Mental retardation	1965	187,384	147.3	16.5
	1970	395,450	302.6	22.9
	1980	676,404	486.5	26.3
	1985	789,025	548.2	27.5
	1987	837,671	572.8	28.3
	1988	825,321	560.0	29.7
	1989	811,081	547.8	31.6
	1990	797,792	537.1	31.3
	1991	785,890	529.8	31.7

In Table 3, the data on incidence pertaining to Russia are given in comparison to indicators for other CIS states. As can be seen in Table 3, these indicators differ somewhat in different regions: they are higher in Ukraine than in Russia, and lower in the other states. The lowest number of registered cases and morbidity rate are in Tajikistan, Turkmenia and Armenia.

**Table 3. Indicators of Incidence of Mental Disorders and Morbidity in Russia, as Compared to Other CIS states, According to Data as of the Beginning of 1991**

State	Incidence		Morbidity	
	number of registered patients		number of new registered cases in 1990	
	absolute	per 100,000	absolute	per 100,000
Russia	2,549,083	1716.1	160,454	108.0
Ukraine	1,005,898	1936.5	71,258	137.2
Belarus	150,011	1462.1	10,118	98.6
Uzbekistan	233,086	1125.6	18,227	88.0
Kazakhstan	243,524	1450.2	13,012	77.5
Azerbaijan	79,677	1116.4	3,852	54.0
Moldova	75,800	1735.7	5,203	119.1

**Table 3. Indicators of Incidence of Mental Disorders and Morbidity in Russia, as Compared to Other CIS states, According to Data as of the Beginning of 1991 (Continued)**

State	Incidence		Morbidity	
	number of registered patients		number of new registered cases in 1990	
	absolute	per 100,000	absolute	per 100,000
Kyrgyzstan	49,963	1129.9	3,376	76.3
Tajikistan	40,692	759.5	2,874	53.6
Armenia	28,878	855.4	1,169	34.6
Turkmenistan	31,016	835.1	2,722	73.3

The data in foreign psychiatric statistics indicate that mental disease is widespread and are correlated with extent of development of the network of psychiatric care. Data on registered patients in Russia (16.7/1000) are quite comparable to the indicators for Bulgaria (14.3/1000), but higher than the number of recorded patients in China (only 5.4/1000) and considerably lower than in Poland (36/1000) where detection and registration of patients are set up very well.

The overall indicator of incidence of mental disorders (16.7/1000) includes diseases that differ in nature and severity (see Table 1). Out of each 1000 population, 6.6 people have serious forms of psychosis and dementia (more than half are schizophrenics), followed by borderline mental disorders (4.8) and mental retardation (5.3).

The results of special foreign studies indicate that the share of individuals requiring systematic psychiatric care constitutes 3 to 6 percent (30-60/1000 population), while the share of the most serious cases is 0.3 to 0.6 percent, i.e., 3-6/1000. The above-mentioned indicator for Russia (6.7/1000) is generally consistent with these figures. This also applies to the indicator for a disease such as schizophrenia, the incidence of which in Russia is 3.9/1000. In other countries this indicator ranges from 1.8 to 8: 6-8 in the United States, 6 in Great Britain, 1.8-5.2 in former socialist states of East Europe, and 3.3 in developing countries.

Data on registered patients are less consistent with indicators of other states with respect to borderline mental disorders (neurosis, psychopathy and others). Since such patients do not require systematic psychiatric observation and care, many of them are not recorded in the official statistics and can be detected only through special epidemiological studies of mental health of different population groups, for example, workers in large industrial enterprises, people serviced by city polyclinics, and population groups such as people over 60 years old, students, and others.

A study of incidence of mental disease among the inhabitants of different parts of Moscow revealed that it is 10 times higher than indicated in official psychiatric records, constituting 176/1000 population (17.6 percent). Only one-quarter of such cases are registered in a neuropsychiatric clinic. A full clinical and epidemiological examination of blue-collar workers in a large

machine-building enterprise in Tomsk also revealed a high incidence of mental disorders—188 per 1000 workers (18.8 percent), which was 3.9 times higher than the data in the official neuropsychiatric records of patients in this population group.

These data, which pertain to both psychoses proper and borderline disorders, allow us to concur with the conclusions of some American specialists,<sup>5</sup> who believe that 15 to 22 percent of the population suffer from some mental illness or mental disorder, and another 5 percent of the population could develop episodic anxiety and similar states in their lifetime. Thus, the cited indicator should be raised to 20-27 percent and constitute 200-270/1000 population.

The structure of morbidity indicators differs from the structure of incidence of mental disorders (see Table 1). While patients registered at a clinic are represented approximately evenly by cases of psychotic disorders (psychosis and dementia), borderline mental disorders on a nonpsychotic level, and mental retardation, the new cases placed under observation in 1991 were distributed as follows (per 100,000 population): psychosis and dementia—30, mental retardation—25.4, borderline mental disorders—46.8. Thus, about half the patients who sought psychiatric care for the first time suffer from mental pathology on the borderline level.

Indicators of morbidity referable to mental disorders, like the incidence rate, differ appreciably in different CIS regions (see Table 3). Thus, while morbidity rate in 1990 was 108/100,000 population in Moscow, it constituted 137.1 and 119.1 in Ukraine and Moldova, respectively, and substantially lower in the rest of the CIS states. Such differences are attributable to social, demographic and cultural factors, difference in population tolerance for the mentally ill, adequate staffing of psychiatric services with physicians, and others.

The observed prevalence of borderline mental pathology reflects a trend that has been developing for many years. Thus, in the last 80 years, the number of recorded cases of neurosis increased by 40 times, whereas the number of cases of oligophrenia increased by 29 times and psychosis by only 3.4 times. Thus, "psychiatry of psychoses," as it prevailed at the start of this century was transformed into "psychiatry of borderline disorders."

These changes resulted in some inconsistency with the guidelines that existed until recently for keeping clinical records of mental patients and placing them under observation. These guidelines, which were developed as far back as the 1930s, were applied mainly to patients with psychosis and provided a number of medically justified social restrictions for them. However, as the years passed, these guidelines began to be extended without justification to all registered patients, including those with borderline (nonpsychotic) mental disorders. Because of the fear of possible social restrictions imposed by getting on the psychiatric records, such patients began to avoid contact with psychiatrists. This led to an annual decline to almost one-half in number of patients with newly established diagnosis of mental disorder on a nonpsychotic level. This is largely the cause of the above-mentioned difference between number of patients recorded by the psychiatric service and their true number.

In view of the foregoing, the rules for keeping records of and registering patients in neuropsychiatric clinics were changed in 1988. The entire group of patients began to be divided into two groups: those subject to clinical registration and dynamic observation, and those not subject to registration, but requiring consultant and therapeutic assistance. As of the beginning of 1992, there were (as we have already indicated) 2,482,109 patients under clinical observation, and another 658,266 were seen by consultants (i.e., actually a total of 3,140,375 people).

The most important conclusion drawn from analysis of data in psychiatric statistics is that in Russia the psychiatric service assists a rather large number of individuals requiring specialized care. About 2 percent of the population is in constant contact with the psychiatric service, including 1.7 percent who are on clinical case records

and 0.3 percent who have been in consultation. However, the number of people requiring psychiatric assistance, if only for a short period in their life, is almost 10 times higher. This estimate coincides with the opinion of foreign experts. This was confirmed by the United States President's Commission on Mental Health in 1972,<sup>6</sup> and by WHO experts.

The structure of indicators of morbidity and incidence of mental disorders in the child population and older age groups differs substantially from data for the entire population, and this is attributable to the specifics of mental pathology inherent in these age periods, as well as considerable difference in the system of rendering psychiatric care to these population groups. For this reason, statistics characterizing morbidity for mental disorders are discussed in different sections for the child and advanced age population groups.

#### Mental Illness in Children

The incidence of mental illness in children is generally calculated for the age group to 14 years (inclusive). Adolescents and young people of an older age are included in the adult population or else an adolescent group (15-17 years old) is singled out. But rates for the entire population are also calculated.

Table 4 shows that as of the beginning of 1992, according to clinical records, the incidence of mental disorders in children up to 14 years old calculated for the entire population is 338.9/100,000 (or 3.4/1000). As compared to cases in all age groups (see Table 1), prevalence of borderline (nonpsychotic) mental disorders and mental retardation is evident in the structure of mental illness in children. As for psychosis, its incidence in childhood is relative low (13.6/100,000 population).

**Table 4. Incidence of Mental Disorders in Russia According to Clinical Records in Age Group Through 14 Years as of Beginning of 1992**

Group of mental diseases	Number of cases in relation to population of same age		Number of cases in relation to entire population	
	per 100,000	per 1,000	per 100,000	per 1,000
All diseases	1497.7	14.98	338.9	3.39
Psychosis	60.4	0.60	13.6	0.14
Borderline (nonpsychotic) mental disorders (including borderline retarded development)	726.8	7.27	164.5	1.65
Mental retardation	710.5	7.11	160.8	1.61

If the incidence of mental disorders is calculated only for children up to 14 years rather than the entire population (see Table 4), the rates, of course, become higher, but the ratio between incidence of psychosis and incidence of milder mental pathology (borderline disorders and mental retardation) remains the same.

Thus, in children there is prevalence of nonpsychotic forms of mental disorders and mental retardation (oligophrenia). For this reason, problems of school maladjustment, behavioral disturbances and disabled children

(among those disabled since childhood due to mental illness, 80 percent are in the most serious group I of disability) are the most important in child psychiatry.

In view of the poor ecological situation, the sequelae of exposure to various deleterious environmental factors (including radiation), as well social conflicts, migration of the population and others are acquiring increasing importance. Unfortunately, these problems have not yet been sufficiently studied.

Cultural distinctions of a specific region and level of organization of psychiatric care of children affect detection of mentally sick children and organization of care for them even more than for the adult population (Table 5).

**Table 5. Indicators of Registered Sick Children According to Data for Beginning of 1991  
(per 1000 children to 14 years old)**

Group of mental diseases	Country			
	Russia	Ukraine	Belarus	Turkmenistan
Psychoses (all)	0.64	0.42	0.33	0.170
Including schizophrenia	0.11	0.05	0.06	0.007
Borderline (nonpsychotic) disorders and retarded development	7.77	14.67	8.31	1.390
Mental retardation	7.69	5.81	5.11	1.790

Even in Russia, where psychiatric care for children is better organized than in other CIS states, we find that psychiatric records of children are incomplete. This is indicated by data of relevant epidemiological studies, in which some children groups were examined by a psychiatrist. For example, an epidemiological survey of very young children in Moscow revealed that 14 percent had mental deviations, i.e., 140/1000 children of the same age (the foreign indicators range from 60 to 120/1000 children).

Existing differences in indicators in records of sick children from urban and rural areas, 13.7 and 4.6/1000 children up to 14 years old, are also related to the level of organization of psychiatric assistance. For the rural group, considerably fewer patients are detected and registered due to the distance from psychiatric assistance. However, special epidemiological studies prove that in reality the number of sick children is about the same among the urban and rural population, 108.4 and 109.2, i.e., there is a wide difference between indicators of incidence of mental illness obtained from official sources and on the basis of special epidemiological studies. This difference is much more marked among children (by 8-27 times) than adults (4-10 times).

In child psychiatry, unlike adult psychiatry, not only existing pathology, but also the risk of its future development are taken into consideration. For this reason, so-called risk groups are singled out. They include children born to psychotic parents, children exposed to some strong environmental factor (for example, accidents), those suffering from serious somatic diseases, and others. They should be placed under active observation of child psychiatrists, neurologists and child psychologists. Of all child risk groups (for different diseases), children at risk for future development of some mental disorder constitute 30-35 percent. Early detection of such children is extremely important in order to preserve their mental health in the future, but nevertheless expressly these groups are still being detected very inadequately by the psychiatric service for children.

#### Mental Disturbances in Old Age

The incidence of mental disorders among individuals over 60 years of age is higher than the general population. According to the results of epidemiological studies, it constitutes 274.4/1000 of the same age (27.4 percent). These figures, which were obtained in our country, are analogous to the findings of foreign epidemiological studies, according to which various mental disturbances are found in 20-30 percent of the aged population.

The relatively high share of severe mental disorders, in particular psychosis and dementia, which are encountered at a rate of 66.5/1000 population, i.e., 6.7 percent of those over 60 years old, is a distinction in the structure of psychiatric morbidity in old age. In this age group, the incidence of milder mental disorders is even higher, 208/1000, or 20.8 percent.

In spite of the relatively higher incidence of serious forms, psychiatric institutions detect mental disorders among the aged less often than among individuals of employable age. Only one-tenth of the elderly and aged with mental disorders are on the records of neuropsychiatric clinics. The indicator of registered incidence of mental disturbances among the population 60 or more years of age constitutes only 26.2/1000 of the same age. And in the group of recorded elderly and aged patients the share of serious mental disturbances was higher than in the structure of incidence of mental pathology in old age established by epidemiological studies. Severe mental disorders prevail dramatically over mild ones (3.8:1), which is indicative of obviously inadequate detection of the latter by psychiatric services.

There is also a large share of serious mental illness in the structure of recorded morbidity as determined by the number of new patients who sought psychiatric assistance in 1 year. Thus, in 1980, this indicator constituted 160.1/100,000 population 60 or more years of age, and incidence of psychosis and dementia was 117.7/100,000 population of the same age, while milder forms of mental disorders constituted 42.4/100,000 of the same age.

In the 1970s, the indicators of registered incidence of mental disorders rose by 8.7 percent in Moscow. However, this rise was not attributable to improved detection

of elderly patients. Only indicators of recorded serious forms of mental pathology rose, which was related primarily to aging of patients placed on clinical records at an earlier age, and accumulation of aging patients in boarding facilities for chronic mental cases.

## II. Sequelae of Mental Diseases

### Disability Due to Mental Illness

Mental illness is in the category of human ailments that is most often associated with decline and loss of fitness for work. In Russia, the total number of people disabled as a result of mental illness and mental retardation reached 618,250 in 1991, which is 24.3 percent of all registered mental cases. In recent years, according to indicators of primary determination of disability, mental illness has been in 6th-7th place among all classes of disease. However, in the disabled group as a whole, overall, the group of people disabled as a result of mental illness and mental retardation is in 4th place, constituting 0.42 percent of the population as a whole. The share of mental patients is 15-18 percent of all invalids certified annually by VTEK [medical commission for determination of disability].

With respect to severity, only disability due to oncological pathology is ahead of disability due to mental disease and mental retardation. Thus, as of the beginning of 1991, 92.3 percent of mental patients were in disability groups I and II (the most severe ones, with total loss of work capacity), and only 7.7 percent in disability group III. Mental pathology involves longer disability than any other class of diseases. Most of the mental patients who have lost capacity for work become disabled at a young and middle age: 25 percent at up to 29 years of age, and 70 percent at under 40. Almost 95 percent of the disabled who were deemed unfit for work as a result of mental illness and mental retardation receive pensions for life.

Among the mental diseases most often leading to disability, schizophrenia (40 percent) and mental retardation (31 percent) are in first place. They are followed by mental disorders resulting from epilepsy and organic diseases of the CNS. In recent years, there has been some increase in share of disability due to cerebrovascular disease and aging processes.

Schizophrenics constituted the largest group among those disabled as a result of mental illness. In recent years, there has been both an absolute and relative increase in their number and incidence among the population, from 176,972 (12.8/10,000 population) in 1978 to 248,352 (16.7/10,000) in 1990.

In the last decades, thanks to advances in the treatment of mental illness it has been possible to improve significantly the condition of many patients, which enables them to spend most of their life outside the walls of psychiatric hospitals. At the same time, there was no decline in disability rate. Moreover, between 1978 and

1990 the number of people disabled due to mental illness and mental retardation rose from 443,613 to 618,250, which corresponds to 32.3 and 41.8/10,000 population, respectively. This happened because of an increase in number of group I and II invalids, whereas the share of group III invalids dropped from 16.6 percent in 1978 to 7.7 percent in 1990 (share of group III invalids due to schizophrenia as related to all disabled schizophrenics dropped accordingly from 13.8 to 7.2 percent). To some extent, such dynamics are attributable to the concern of the patients themselves and their relatives to be certified in the more severe disability groups, which afford patients a number of social benefits.

Since most mental diseases associated with loss of work fitness start at a young and middle age and are chronic, they lead to many years of disability, total recovery from which is possible only in isolated cases. The indicator of total elimination of disability group (calculated for a group of patients in one of the rayons of Moscow) dropped from 0.5/10,000 population in 1978 to 0.31 in 1990, whereas the indicator of primary certification of disability in this group, on the contrary, increased and reached 2.3/10,000 population in 1990. Stability of indicators of severity is inherent in disability resulting from mental illness and mental retardation. The disability group rating does not change in 70 percent of the cases throughout the patients' lives. Lowering of disability group or its cancellation is possible only for 7 percent of those disabled as a result of schizophrenia and 11 percent, as a result of oligophrenia. Most often, such positive dynamics are possible only within the first 5 years after disability is certified, when some improvement can be obtained by appropriate therapeutic and psychocorrective measures. With longer periods of disability, worsening is more typical.

All of the above indicators pertain to patients suffering from marked forms of disease and on the official records of health care and social security agencies. Considering the incomplete detection of mental cases by the psychiatric service, inaccessibility of VTEK in some regions (in particular, sparsely populated and agricultural ones), as well as the prejudice on the part of some people against psychiatrists and desire to avoid contact with them, poor knowledge among the public concerning matters of mental health and work of psychiatric care services, we can assume that there is group of unemployable patients that is "concealed" from official statistics, which increases significantly the true loss sustained by society as a result of mental illness and mental retardation.

In view of the chronic nature of illness, high disability indicators and, as a rule, small pensions received by mental patients, they should be classified among the poorest strata of the population.

### Social Restrictions

The negative consequences of mental illness for patients are not limited to decline or loss of ability to work and serious financial situation. The very existence of a

mental illness is fraught with substantial social restrictions, which preclude rehabilitation in society. In spite of the fact that the "Statute on conditions and procedure for rendering psychiatric assistance in the USSR," approved in 1988 in accordance with an Ukase of the USSR Supreme Soviet, expands the legal rights of the mentally ill, there are still numerous departmental instructions and lists in effect that deprive them of the opportunity to attend a number of educational institutions, obtain work in their chosen field, perform prior professional duties, or drive a car. Being on the psychiatric records and, as a result, affected by the obsolete and unjustifiably expanded list of medical contraindications for work in some industry or other, the patients find themselves totally dependent on management, under the constant threat of being dismissed.

Social deprivation of patients is also instrumental in making it impossible to honor medical privilege, since the existence of a mental illness, according to adopted practice, is indicated in many documents used for other than strictly medical purposes (sick-leave certificates, work record book, and others). In view of our society's low tolerance of mental patients, they easily find themselves in social isolation.

#### **Decline and Change in Social Activity of Patients**

The loss sustained by society as a result of mental illness and mental retardation is composed not only of failure of such patients to participate in creating national income. It is also related to distortion of their function in other areas of socioeconomic life.

**Adherence to Legislation, Law and Order.** Individuals with some forms of mental disorders are often in the environment of vagrants, alcoholics and drug addicts, i.e., a criminal environment. There are relatively few patients (about 10,000-15,000 per year) who are deemed to have diminished capacity because of marked mental deviations, which is less than 1 percent of all those prosecuted for crimes) among criminals taken to court for different reasons. However, the share of mental patients deemed by a court to have diminished capacity is larger, about 10 percent, among individuals who have committed particularly serious crimes directed toward people (murder and other aggressive acts).

**Military Service.** Mental pathology constitutes more than 20 percent in the structure of diseases found in 18-year-old men that serve as grounds for an expert ruling that they are unfit for military service. According to data of recent years, oligophrenia constitutes the largest share (50.9 percent) of diagnosed mental disturbances, followed by the group of organic brain pathology (15.8 percent) and psychopathy (15.5 percent). These indicators demonstrate considerable interregional differences (for example, they range from 2 to 43 percent for frequency of diagnosing psychopathy). This is related to both differences in diagnostic approaches and inadequate qualifications of experts who certify young men of

draft age. Improper call-ups due to inadequate assessment of draftees' physical condition are also a reflection of the high incidence of mental pathology in individuals of draft age. Analysis of indicators for sick leave in the first 3 months of emergency service indicates that in different years 50 to 70 percent of those relieved due to illness were individuals with mental disorders that had not been detected in the call-up period.

In the structure of mental pathology diagnosed in individuals relieved from emergency military service (on the example of the Moscow Military District), the share of psychopathies is 47 percent, oligophrenia 30 percent, remote sequelae of organic brain lesions 15 percent, epilepsy 4 percent, alcoholism and drug addiction 2 percent, neurosis 2 percent. In 77 percent of the cases we are dealing with mental illness accompanied by behavioral disturbances.

**Population Reproduction.** It is not deemed possible to describe precisely the general familial function of mental patients (family situation, childbirth, and others), because relevant sociological studies have not been carried out in Russia. Existing data enable us to discuss with certainty only schizophrenics. The marital status indicator (ratio of number of women married before the age of 50 years to total number of women of the same age) is lower than in the population, even with favorable forms of schizophrenia. The indicator for ability to bear children (ratio of number of women up to 40 years who have children to total number of women who have reached this age) for schizophrenics is almost one-third than for the general population.

#### **Economic Expenses on Mental Patients (with the exception of chronic alcoholics and drug addicts)**

It is difficult to estimate with adequate reliability the funds received from the State budget for therapeutic-rehabilitation and social measures related to mental illness, first of all because of the complexity of mechanisms of funding health care institutions, as well as the fact that allocation of such funds is made not only from the "Health care" section, but also other sections of the national budget ("Social security," "Social insurance," and others).

The financial resources allocated from the State budget for mental patients are divided into direct and related ["entailed"]. Direct State expenses for mental patients in 1990 constituted 4 billion rubles. The break down was: 1) expenses for patient treatment—1.4 billion rubles (5.7 percent of the "Health care" budget); 2) expenses for benefits due to temporary sick leave 78.6 million (0.3 percent of "Social insurance" budget); 3) expenses for benefits due to disability, upkeep of VTEK and boarding facilities for chronic mental patients (psychochronics) 1.4 billion (3.5 percent of the "Social security" budget); 4) expenses for upkeep of boarding schools and children's homes for children with mental retardation 1.1 billion rubles (2 percent of "Education" budget). Related

expenses refers to the government's expenses for education and retraining of medical personnel, capital investments for construction and reconstruction of psychiatric institutions, research, and other expenses in the realm of psychiatry. A certain amount of the related government expenses for mental patients constitutes, with more or less reliability, 0.6 billion rubles per year.

In all, direct and related expenses from the State budget for measures related to mental illness amount to 4.6 billion rubles per year, which corresponds to 1 percent of all of its expenses.

In addition to payments from the State budget, for a complete assessment of total government economic expenditures for mental patients one must also take into consideration the shortfall of national income caused by exclusion of mental patients from the production process due to their temporary or permanent unfitness for work. This part of the unproduced national income makes up the indirect government expenses, which amount to 3.6 billion rubles.

Total economic expenditures by the government related to mental illness, consisting of direct, related and indirect expenses, constitute 8.2 billion rubles. This figure is considerably lower than the same indicators in developed foreign countries.

The shortage of funds affects both the operation of existing psychiatric institutions and services, and construction of new ones. The actual capital intensiveness of a hospital bed in the best psychiatric clinic in the nation (Research Institute of Clinical Psychiatry, RAMS Mental Health Research Center) is only 12,000 rubles, whereas the norm for specific capital investment is 2-2.5 times higher. It is defined at 25,000-30,000 per bed).

As a result of the very low allocations for acquisition of drugs and medical equipment the cost per day in a psychiatric hospital does not exceed an average of 12 rubles in Russia, whereas this indicator is in excess of 14 rubles for all hospital institutions of the country. The additional amount of funds for drugs alone should constitute, according to our estimates, 271.6 million rubles per year (in 1990 prices) for all psychiatric hospitals.

### III. Condition of Psychiatric Service

In the Russian Federation there is a State system of psychiatric care for the people, which is based on institutions of the RF Ministry of Health: regional psychiatric hospitals, semi-infirmaries, neuropsychiatric clinics and other extramural institutions situated over the nation's entire territory. In addition, psychiatric assistance is given within the system of medical services of different agencies, polyclinics and infirmaries of self-supporting medical institutions and medical cooperatives.

#### General Psychiatric Network and Its Activities

Table 6 lists the main indicators for mental health services in Russia, and it shows that as of the beginning of 1992 there were 195,961 psychiatric beds in 288 psychiatric hospitals, 97 infirmaries in neuropsychiatric clinics, as well as in psychiatric wards of drug-abuse, oblast, city and central rayon hospitals, hospitals for veterans of the Great Patriotic War, emergency hospitals, VUZ and research institution clinics. Availability of psychiatric beds constituted 13.2 beds/10,000 population. It was only slightly behind the standard—14.8 beds/10,000.<sup>8</sup> The existing beds were occupied by 619,030 patients in 1991, or 41.8 people/10,000 population.

**Table 6. Main Indicators of Development of Network of Mental Health Services in the RF Ministry of Health System for the Last 25 Years**

Indicator	1965	1980	1985	1987	1988	1989	1990	1991
Number of psychiatric hospitals wards	232.00	280.00	286.00	289.00	286.00	288.00	293.00	288.00
Number of psychiatric beds in all types of hospitals (psychiatric hospitals, psychiatric wards of somatic hospitals, infirmaries in neuropsychiatric clinics, clinics of research institutions, medical institutes and others)	125,351.00	181,154.00	191,856.00	193,812.00	193,611.00	195,936.00	198,872.00	195,961.00
Availability of psychiatric beds (per 10,000 population)	9.90	13.00	13.30	13.20	13.10	13.20	13.40	13.20
Infirmaries at neuropsychiatric clinics	70.00	89.00	95.00	92.00	86.00	87.00	89.00	97.00
Spaces in day infirmaries	1,069.00	6,210.00	8,265.00	9,470.00	10,267.00	11,136.00	11,198.00	11,558.00

**Table 6. Main Indicators of Development or Network of Mental Health Services in the RF Ministry of Health System for the Last 25 Years (Continued)**

Indicator	1965	1980	1985	1987	1988	1989	1990	1991
Availability of space in day infirmaries (per 10,000)	0.01	0.45	0.57	0.65	0.70	0.75	0.75	0.78
Number of neuropsychiatric clinics	116.00	138.00	145.00	143.00	140.00	142.00	142.00	154.00
Medical and preventive care institutions with clinic departments or offices	609.00	1,571.00	1,874.00	2,400.00	2,465.00	2,487.00	2,582	—
Visits to outpatient-polyclinic institutions (per 10,000 population)	480.00	1,150.00	1,440.00	963.00	897.00	840.00	839.00	—
Space in occupational therapy workshops	11,762.00	36,954.00	43,701.00	44,815.00	45,253.00	45,620.00	47,069.00	43,874.00

In 1990, outpatient-polyclinic psychiatric assistance was rendered to patients in 142 neuropsychiatric clinics and 2582 clinical departments or offices in various general medical and preventive care institutions. In 1990, 12.5 million people, or 839/10,000 population were seen as outpatients by psychiatrists. Every 19th outpatient visit resulted in hospitalization of the patient.

In commenting on hospitalization indicators, let us recall that the morbidity rate for mental disorders in Russia was 10.2/10,000 population in 1990. This means that each year there is about 3 times more hospitalization of already existing cases than new ones. Studies conducted at the RAMS Mental Health Research Center indicate that about 40 percent of these hospitalizations could be avoided with adequately organized care. Thus, the hospitalization level could be about 30 cases/10,000 population/year.

Moreover, the psychiatric service has a network of so-called semi-infirmary institutions, the chief form of which are the day infirmaries. In 1991, they had space for 11,558 people, i.e., 0.78 space per 10,000 population. This is several times less than the actual need which, according to estimates of specialists, is 3 spaces per 10,000. At the present time, in reality it is possible to refer only 4 percent of the patients seeking outpatient care for treatment at day infirmaries attached to a clinic, rather than an ordinary psychiatric hospital.

Availability of work places at occupational therapy workshops is also inadequate. In 1991 it constituted only 43,874 work places for more than 0.5 million disability groups I and II patients. There are only isolated private farms and special shops at industrial enterprises where mental patients work.

We should stress in particular the absence of formalized psychotherapy in the Russian Federation. The psychotherapy offices existing at some polyclinics and clinics (based on 1 psychotherapist per 30,000 adult population) by no means meet the actual need for this form of

assistance. The emergency psychological care service organized in Moscow and a few other major cities for suicide prevention (so-called "confidential telephones" and "crisis" infirmaries) cannot resolve general problems of psychotherapy and psychoprophylaxis.

A study of dynamic development of the psychiatric service in the last 25 years, from 1965 to 1991 (see Table 6) reveals that availability of psychiatric beds in this period increased from 9.9 to 13.2/10,000 population, i.e., by 33 percent. Rise in number of neuropsychiatric clinics by 31 percent proceeded at virtually the same rate. We also observed a significant increase (4.2-fold) in number of clinic wards and psychiatric offices in general medical outpatient-polyclinic institutions. In this period, the number of outpatient visits to psychiatrists increased by 1.7 times.

Day infirmaries developed with less intensity: since 1980, the space in them increased from 0.45 to 0.78/10,000 population, constituting only 25 percent of the need. The government directive in force prior to formation of the CIS to build and operate new day facilities in 1981-1985 was only 16 percent fulfilled in Russia. Work places in occupational therapy workshops doubled within this period, but availability continues to be extremely inadequate.

Mean duration of stays in psychiatric hospitals of Russia constituted 98 days in 1991. This figure has changed little in recent years (96.5 days in 1986, 93 in 1987, 94.4 in 1988, 94.7 in 1989, 94.5 in 1990), although there has been a decline since 1970 when it constituted 108.6 days. Such lengthy hospital care does not conform to the therapeutic capabilities and requirements of modern psychiatry. In many western countries hospital treatment is of much shorter duration. These indicators are lowest in the United States: mean hospitalization there constituted 36 days in 1970, and only 15-20 days in 1988.<sup>9</sup>

The duration of hospitalization in our hospitals is related to some extent to the lack of modern diagnostic and

therapeutic resources, and poor availability of drugs. The heavy workload of physicians, shortage of qualified mid level medical personnel and social workers are also important. Moreover, it must be borne in mind that up to 40 percent of the hospital bed resources are occupied by chronic patients, who cannot be discharged because of absence or overt shortage of rehabilitation facilities and extramural housing for them. The psychiatric boarding facilities existing at the present time in the system of the Ministry of Social Security provide essentially the only form of sociomedical assistance for chronic patients. But, because of the poor level of rehabilitation work in such boarding facilities and shortage of qualified personnel, drugs and equipment, they obviously do not cope with the task of social rehabilitation of the disabled and serve merely as caretakers.

In spite of the fact that patient treatment in Russian hospitals is rather lengthy, they do not have a full workload. This is evident from one of the most important criteria of hospital performance—number of days of bed occupancy per year (occupancy of bed-days per year in relation to mean annual number of beds). In 1990, this indicator averaged 316 days in Russia, as compared to 358 days in 1986. The decline in number of days of bed occupancy per year reflects expansion of the progressive trend toward treating patients under extramural conditions.

Relevant estimates show that, according to 1990 data, more than 10 percent of the existing bed resources in Russia were not used, and they remained unoccupied while their funding was retained. For this reason, in the interests of patients, we could raise the question of reducing the number of beds in psychiatric hospitals that are not full or operate ineffectively. This would permit substantial improvement of patient upkeep and treatment conditions, as well as working conditions of medical personnel, without reducing funding for such hospitals.

It should be noted that, in Russia, in addition to the main network of psychiatric institutions that operate on the territorial principle, there are independent psychiatric services in the system of medical facilities under different agencies and institutions. Each such service, operating independently within the limits of its agency or management, in resolving practical problems proceeds first of all from the interests of the agency to which it is subordinated. The patients assisted by these services are not included in general statistics or in the data cited above.

Thus, the psychiatric services of the Ministry of Defense, Ministry of Internal Affairs, Ministry of Railways, Ministry of Civil Aviation, Ministry of the Maritime and River Fleet, and others are independent of the RF Ministry of Health. Within the RF Ministry of Health itself, there is an autonomous psychiatric service of the third and fourth administrations. There is a vast network of psychiatric institutions under the management of the Ministry of Social Security and Committee for Public

Education. Moreover, many outpatient psychiatric and psychotherapeutic offices are organized at health centers, polyclinics and hospitals under various other ministries, agencies, enterprises and large institutions. Some psychiatric care is given to the public at polyclinics and hospitals in the system of self-supporting medical facilities, medical cooperatives and individual psychiatrists in private practice.

The existence in the Russian Federation of several systems of rendering psychiatric assistance makes it difficult to manage and coordinate the work of relevant institutions. Needed systematic information, on the basis of which an idea is gained about organization and performance of mental health services in the country at the present time is received only from institutions in the system of the RF Ministry of Health. There is no single data bank in the nation about the entire network of psychiatric facilities, how they are equipped and manned. A situation has developed in which there is no center to which relevant information can be forwarded.

#### Psychotherapeutic Assistance for Children and Adolescents

Unlike the single system of general pediatric care existing in our country, which is available to virtually every child, the existing standards for providing the child and adolescent population with psychiatric care are such that a considerable part of patients with mental disturbances cannot obtain the services of a psychiatrist. The very system of organizing the child and adolescent psychiatric service is also flawed.

Extramural psychiatric care is rendered in essence only in large cities. In small towns and rural areas there is very little or no specialized psychiatric assistance for children and adolescents.

A pediatric psychiatric hospital service is developed only in Moscow. In the rest of the Russian territory it is represented by small (30-60 beds) wards that are not specialized and included in the structure of general psychiatric hospitals. In most regions of Russia there is no adolescent psychiatric service. There are merely a few wards for adolescents in psychiatric hospitals of a number of large cities. In Russia as a whole, availability of psychiatric beds for children constitutes 3.2/10,000 child population. There is particularly poor representation of neuropsychiatric sanatorium care, which is so needed by children with mild, correctable mental disorders. While there were 20,000 sanatorium beds for children in Russia before the Great Patriotic War, only 2000 remain at the present time.

Children with retarded mental development are not provided with specialized education. Schools or remedial classes for such children exist only in a few large cities and service a very small number of children. Nor has there been a solution to the problem of care of very young children, up to 3 years old (micropsychiatry), so

that a considerable number of very young children with incipient mental disorders do not receive specialized psychiatric care.

In essence, there is no service in Russia for psychological correction, without which early preventive work with children is impossible (particularly among children in high risk groups for mental pathology). In our country, thus far a few psychological outpatient offices for adolescents have been opened only in Moscow and St. Petersburg. There is still no functional service for genetic consultation of families on the risk of mental disorders. The scope of genetic consultations provided mainly at research centers (psychiatric and genetic) is extremely limited. Development of child psychiatry services in many countries of the world is proceeding along the lines of establishing special mental health centers, where parents and their children have the opportunity to obtain qualified consultations with different specialists. As yet there are no such centers in Russia.

Thus, the specialized psychiatric service for children and adolescents in our country does not meet the needs of the public for such type of assistance, and urgent steps must be taken to develop and improve it.

#### **Psychiatric Care for the Elderly and Aged**

In our country there is no specialized gerontological and gerontopsychiatric care, and for this reason elderly patients with marked mental disorders are serviced by psychiatrists in the general network of psychiatric institutions. As a rule elderly patients get the attention of the psychiatric service at the stage of very advanced illness (psychosis or dementia), whereas early and relatively milder forms of mental pathology remain outside the range of medical supervision. Even in the most favorable territory in this respect (Moscow) only one-tenth of elderly and aged patients are registered.

For this reason, there is a need to establish a broad network of gerontopsychiatric offices and consultation facilities accessible to the elderly, both in psychiatric clinics and general medical polyclinics. This would lower appreciably society's expenditures for upkeep and inevitable expansion of the network of facilities for long-term stays of patients with neglected forms of disease—special psychiatric boarding facilities within the system of the Ministry of Social Security. If, however, a sociomedical and outpatient specialized service is not created in the next few years, which would help the elderly and aged to live in society independently, the number of beds in boarding facilities for lifetime stays of individuals with dementia will almost double, in accordance with demographic changes.

#### **Interagency Sociopsychiatric Institutions for Special Patient Groups**

Sociomedical assistance for mental patients is rendered by institutions and organizations under the jurisdiction of different agencies (ministries of health, social security,

education). The gap that exists between agencies causes problems in organizing such care for chronic mental patients, including children and the elderly.

Child institutions of this type give specialized care to children with sight and hearing disturbances, sequelae of organic brain lesions (for example, sequelae of infantile cerebral palsy), as well as different forms of mental retardation. Most mentally retarded children and all disabled children suffering from the consequences of infantile cerebral palsy, blindness and deafness require special education. The rest are serviced by social security institutions (patients with rather profound mental retardation). In addition to general medical care, such children need specialized psychiatric care, since the above physical and neurological defects are always associated with functional mental pathology.

There is a very great need for such specialized care, and it is not fully met in our country. At the same time, increasing attention is being given to the fact that the concentration of this category of children in specialized institutions, in isolation from healthy society, is socially unfavorable. After staying in such institutions in childhood and adolescence, patients become severely maladjusted socially, unadapted to ordinary living conditions, and they require the constant support of society.

In recent years, another approach to organization of sociomedical care of the disabled, including children, is gaining popularity in world psychiatry. It involves deconcentration of children with medium or mild defects among healthy children, i.e., introducing them to ordinary child groups starting at a preschool age (1 sick child per group of 7-10 healthy ones). This increases funding and social assistance for child institutions (nursery and regular schools, and others), and provides for having psychologists and neuropsychiatrists work there. In such nurseries and schools there are individual teaching programs, along with those for healthy children. The experience already gained in western countries of joint education and upbringing of sick and healthy children indicates that, with proper orientation and special training of teachers and educators, healthy children are willing to help their weaker friends who are behind in their education.

Such approaches have not yet been developed in the Russian Federation, but we consider it mandatory to study available foreign knowhow, along with improvement of care within the limits of existing organizational forms.

Neuropsychiatric boarding facilities are an organizational form of rendering social assistance to adult mental patients in the system of the Ministry of Social Security. At the present time, there are about 126,000 people in such facilities, or 8.4/10,000 population. Neuropsychiatric boarding facilities not only fail to perform functions of resocialization and occupational recovery of the patients in their care, on the contrary, they deprive patients of any hope of ever returning to ordinary life. In

the first place the conditions for being admitted to such facilities, which require mandatory acknowledgment that a patient is incompetent, removal (virtually forever) of his passport, housing (with elimination from the house register), and cessation of disbursement of pension are instrumental in this situation. Such a facility becomes a permanent boarding facility without any prospects of being discharged, even if the mental condition improves.

The situation in neuropsychiatric boarding facilities is aggravated by the fact that aged mental patients have been accumulating in them in recent times. At present, they constitute two-thirds of all individuals in such facilities. Obviously, this has led to dramatic increase in demands as to level of medical services. However, personnel of such facilities cannot provide it, since the norms for medical services (regular staff, medical equipment) and personnel training are inadequate. This can be illustrated by comparing the scheduled staff roster of neuropsychiatric boarding facilities and psychosomatic wards of general hospitals, where a significant part of the patients consists of elderly people (Table 7).

**Table 7. Workload of Personnel in Neuropsychiatric Residential Facilities and Psychosomatic Wards of General Hospitals**

Specialist	Number of patients per specialist	
	neuropsychiatric boarding facility	psychosomatic hospital
Psychiatrist	150	30
General physician	1600	40
Registered nurse	100	15
Aide	25	10

The shortage of physicians, service personnel and poor outfitting of boarding facilities with medical equipment makes it difficult to administer even emergency care, for example, in cases of cardiovascular or other somatic disorders.

There should be a special study, jointly by specialists of both agencies, of the desirability of further existence of institutions for mental patients in the social security system. Perhaps, basically new organizational forms could be created on their basis, for example, rehabilitation, geriatric medical psychiatric wards and departments of the hostel type for patients who have lost social ties.

#### **Psychiatric Care for Individuals Exposed to Severe Mental Stress**

In our country, general medical services dealing with care of accidents and natural disasters began to be established very recently. Organization of such services is also necessary in psychiatry. At the present time, there are small centers and groups of specialists (in Moscow and Tomsk) whose work involves mainly assistance for individuals

with acute mental pathology caused by mass psychotraumatic factors (in disaster, accident zones, and others). However, they do not render systematic assistance to patients suffering from chronic forms of posttraumatic stress disorder, i.e., at the long term after trauma occurred (in addition to the patients mentioned, there may also be victims of social and military conflicts).

Such medical and psychiatric services exist in most countries (United States, Great Britain, France, Canada, Australia, and others). It is imperative to make immediate use of relevant knowhow in order to accelerate significantly resolution of these problems in our country. But it should be borne in mind that organization of comprehensive medical, including psychiatric and psychological, care for victims of mass incidents can be fully accomplished only with prompt receipt of needed epidemiological statistical information. In this regard, we can raise the question of relevant studies, on the basis of which not only methods of examining large groups of people under conditions of natural and other disasters, but also of rapid and effective receipt of medical statistical information, its systematization and assessment on the level of world statistics, methods of singling out groups of victims according to severity of mental disturbances in order to organize differentiated psychiatric and psychological care for them with consideration of the need for long-term observation.

There is also a need to revise the guidelines for funding rehabilitation, psychocorrective and psychopreventive work, and relevant research programs. Thus, for example, all programs for assistance to war veterans, including research programs, are paid for by the Ministry of Defense in most foreign countries (United States, Great Britain, Canada, Australia, and others), although civilian specialists implement them. In Russia, however, thousands of veterans of the Afghan war, including those with chronic posttraumatic stress disorders, are treated mainly at the expense of the health care and social security systems.

Thus, Russian health care requires establishment of a special service for psychiatric assistance to individuals exposed to severe mental stress. (Ending will be published in next issue of this journal.)

#### **Footnotes**

1. This material is a report prepared by the RAMS [Russian Academy of Medical Sciences] Mental Health Research Center for the President, parliament and government of Russia, the Russian Academy of Medical Sciences and RF Ministry of Health. The following specialists participated in preparing the report: M.Ye. Vartanyan, RAMS academician; A.S. Tiganov, corresponding member of RAMS; professors S.I. Gavrilova, V.A. Kontsevoy, D.D. Orlovskaya, G.P. Panteleyeva; doctors of medical sciences I.A. Kozlova, N.A. Mazayeva, V.G. Rotshteyn, S.Yu. Tsirkin, M.Ya. Tsupulkovskaya, L.M. Shmaonova, V.S. Yastrebov; candidates of medical

sciences V.Ya. Yevtushenko, G.V. Kozlovskaya, T.M. Loseva, T.A. Solokhina; S.N. Yenikolopov, candidate of psychological sciences; scientific associates T.A. Grigoryeva, P.V. Kamenchenco, L.S. Shevchenko. Information needed for this report was also furnished by M.B. Kutuzov, L.I. Korsakov, and A.S. Karpov, associates in the former USSR ministries of defense and health; Z.I. Kekelidze, doctor of medical sciences, deputy director of the Research Institute of Psychiatry imeni M.M. Asatiani; B.S. Polozhiy, deputy director of the Research Institute of Mental Health, Tomsk Research Center, RAMS, doctor of medical sciences; and L.P. Yakutonenok, chief physician of the same institute, for which the authors express their appreciation.

In 1992, the report was transmitted to the President of RF, Chairman of the Supreme Soviet and chairman of the Supreme Soviet Committee for Health Care, Social Security and Physical Culture, president of RAMS, health minister and first deputy minister of health of the Russian Federation. After this, new figures were added to the paper, and it was somewhat shortened by eliminating tables with data for different CIS states.

2. Society's concern about this problem has also been reflected in the general press, where the process of "debilitation" of our society is acknowledged (OGONEK, 1991, No 34, pp 30-31).
3. In this issue, the first three parts of the paper are being published. A continuation will be published in the next issue.
4. The material submitted was based on data obtained as of the beginning of 1991. In preparing for publication, the data in the tables were replaced or augmented (for Russia) by statistical information as of the beginning of 1992, which were kindly provided by the Federal research and methodological center for analytic and information problems of psychiatry (headed by A.A. Churkin, doctor of medical sciences). However, in some instances, the former indicators were left in the text, since no basic changes had occurred.
5. AM. J. PSYCHIATRY, 1985, Vol 142, No 7, p 838.
6. "Report of the President From the President's Commission on Mental Health," Washington DC, 1978.
7. Expenses in 1990 prices for mental patients were determined on the basis of official statistics of the former USSR Ministry of Health contained in the statistical annual: "Narodnoye khozyaystvo v SSSR v 1990 g." [The National Economy of the USSR in 1990], and data submitted by various agencies (social security, education and others).
8. Tentative standards for meeting the needs of the public for outpatient-polyclinic and hospital care for the period up to 2000 were elaborated by the Research Institute of Social Hygiene, Economics and Public Health Management imeni N.A. Semashko.

9. However, these indicators should also be critically received. They reflect the trend, which appeared in postwar foreign psychiatry, toward "getting patients out of hospitals." With all the progressiveness of this trend, by now negative consequences of this process have also been observed: patients with acute psychosis are often discharged from hospitals before being completely cured, adding to the group of chronic mental patients who are not in hospitals, who are left without needed assistance and treatment, making up a significant part of the homeless, residents of different types of public shelters and prisons.

Izdatelstvo "Meditina," 1994

#### Method of Storing and Shipping Bacterial Cultures Using Paper Disks

957A0138A Moscow KLINICHESKAYA LABORATORNAYA DIAGNOSTIKA in Russian No 5, May 94 (manuscript received 31 Dec 92) pp 45-46

[Article by Yu.M. Feldman and L.G. Makhaneva, Zhitomir Oblast Children's Hospital; UDC 579.8.083.13]

[FBIS Translated Text] Each bacteriological laboratory's need for a set of standard collection cultures is obvious [1]. But such a collection requires constant reinoculation of cultures, the shelf life of which is limited to 1-3 months. With frequent subculturing, there is loss of many properties of microorganisms, and possible contamination of standard cultures with extraneous microflora. All this requires considerable labor, while the bacterial cultures require periodic replacement. Some difficulties arise when shipping bacterial cultures. The proposed methods [2] do not eliminate these difficulties. We are proposing a simple method of storage and shipment of cultures of microorganisms, which precludes the need for subculturing and prolongs considerably their shelf life.

**Material and Methods.** Collection cultures of bacteria (*Salmonella typhi*, *S. enteritidis*, *Shigella flexneri* 3<sup>a</sup>, *Escherichia coli*, *Klebsiella pneumoniae*, *Sh. sonnei*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes*, *Str. pneumoniae*, *Corynebacterium diphtheriae* var. *gravis tox* (+), *Proteus mirabilis*) were inoculated on 1 percent sugar broth with addition of 20 percent horse serum. The cultures were incubated at 37°C for 24 h. Sterile cardboard disks manufactured by the Moscow "Antigen" NPO [scientific production association] were placed in Petri dishes, 100 in each, and covered with broth cultures of the desired microorganisms. After the disks were saturated surplus fluid was drawn off.

The disks were dried at room temperature for 24 h and placed in sterile tubes sealed with rubber stoppers. The tubes were stored in the refrigerator at 4-8°C for 1 year. Each disk absorbs 0.01 ml fluid. Since the concentration of bacteria in broth cultures after 24-h exposure is constant and constitutes about 2 billion microbial bodies (concentration M) per ml, each disk contained about 20 million microbial cells.

In the absence of cardboard disks, one can use squares of sterile filter paper 5x5 mm in size, or they can be punched out of the filters.

**Results and Discussion..** Each month we removed one disk from each tube and placed them in beef-extract broth or 20 percent serum broth (for cultures of *Str. pyogenes*, *Str. pneumoniae*, *C. diphtheriae*). After incubation for 24-48 h at 37°C, in every case we observed visible growth of cultures of the original microorganism. After inoculation on appropriate solid nutrient media, we tested their morphological, tinctorial, biochemical, and serological properties, formation of capsules in *Str. pneumoniae* and toxicogenic properties of *C. diphtheriae*. All of the cultures studied retained their original properties after 1 year of storage (duration of observation period) on disks.

Addition of glucose and horse serum to liquid nutrient medium (beef-extract broth) used to grow bacterial cultures, aside from enhancing growth qualities (these ingredients are necessary for culturing streptococcus and *C. diphtheriae*), was done for another purpose: these substances protect against heat and extend microorganism storage time. Use of lyophilization on the disks with cultures and more refined heat protectors apparently permits even greater extension of storage time.

The disk-preparing procedure can be simplified for shipment of bacterial cultures, since in this case there is no need for long-term storage of bacteria. A thick suspension of agar culture is prepared and used to saturate sterile disks. The latter are placed in sterile penicillin vials and tightly sealed. In this form, the disks are ready for shipment with adherence to appropriate rules. There is reason to believe that viral cultures can be stored and shipped on paper disks. The proposed method for storage and shipment of bacterial cultures requires less labor related to maintaining standard collections of microorganisms. It should be noted that this method is used by some foreign firms for commercial purposes [3]. The method of storing cultures on paper disks can be recommended for commercial release and centralized supply of sets of standard cultures to bacteriological laboratories of sanitary-epidemic-control and medical-preventive care institutions.

#### References

1. Birger, M.O., ed., "Spravochnik po mikrobiologicheskim i virusologicheskim metodam issledovaniya" [Guide for Microbiological and Virological Methods of Investigation], Moscow, 1982.
2. Uspanova, S.A., and Rayushkin, B.V., KLIN. LAB. DIAGN., 1992, No 3-4, pp 10-11.
3. "Difco: Quality Products for Microbiology," Detroit, 1990.

Izdatelstvo "Meditina," 1994

#### Accreditation of Clinical Diagnostic Laboratories

95TA0138B Moscow KLINICHESKAYA  
LABORATORNAYA DIAGNOSTIKA in Russian  
No 5, May 94 (signed to press 25 Oct 94) pp 46-47

[Article under the rubric "Organization of Laboratory Service"; UDC 616-074.003.2]

[FBIS Translated Text] At the request of readers, we are publishing here Order No 295 dated 21 December 1993 of the RF Ministry of Health "On approval of Statute on accreditation of clinical diagnostic laboratories."

The following participated in preparing the Statute on Accreditation of Clinical Diagnostic Laboratories: V.F. Kuzin (RF Ministry of Health and the Medical Industry), A.I. Zhabin, V.A. Mochalov (All-Russian Institute for Research and Testing of Medical Equipment), V.N. Malakhov (State Preventive Medicine Research Center, RF Ministry of Health and the Medical Industry), V.V. Menshikov, L.M. Pimenova, N.B. Sametskaya, T.I. Lukicheva, O.G. Kadashova (Scientific Methodological Center for Diagnostic Clinical Laboratories), RF Ministry of Health and the Medical Industry), B.S. Kaplan (Polyclinic No 171, Moscow).

Order No 295 dated 21 December 1993 of the RF Ministry of Health "On approval of the Statute on Accreditation of Clinical Diagnostic Laboratories."

For purposes of preparing medical and preventive care institutions for work under conditions of budgeted and insured medicine and to improve the effectiveness of their activities, I hereby approve the following:

Statute on Accreditation of Clinical Diagnostic Laboratories (Appendix).

I hereby order that:

1. The health ministers of republics of the Russian Federation, heads of main administrations, health administrations, departments and committees, Main medical administration of Moscow, heads of medical and preventive care institutions under republic jurisdiction adopt for their guidance and implementation the Statute on Accreditation of Clinical Diagnostic Laboratories approved in this order.
2. Order No 285 dated 16 July 1990 of the USSR Ministry of Health "On implementation of RD 42-19-901-90": "Methodological instructions on certification of clinical diagnostic laboratories" be rescinded.
3. A.M. Moskvichev, first deputy minister, be assigned to monitor implementation of this order.

[signed] Minister E. A. Nekhayev

**Appendix to Order No 295 dated 21 December 1993 of the RF Ministry of Health****Statute on Accreditation of Clinical Diagnostic Laboratories**

This statute spells out the general procedure for organization and implementation of accreditation of clinical diagnostic laboratories in accordance with RF Ministry of Health orders No 93, dated 20 March 1992, "On steps to implement the law of the Russian Federation 'On health insurance of citizens,'" No 148 dated 28 June 1993 "On licensing and accreditation of medical institutions," and No 201, dated 24 August 1993, "On addenda and amendments to Order No 148 dated 28 June 1993."

**1. General Points**

- 1.1. Accreditation of clinical diagnostic laboratories (CDL) is carried out for the purpose of establishing and officially acknowledging conformity of laboratory activities to requirements stipulated in standards and specifications documentation (SSD). A laboratory is accredited for applied types of work.
- 1.2. Both independent CDL and CDL that are a part of medical and preventive care institutions (MPI) are subject to accreditation, regardless of subordination and forms of ownership.
- 1.3. Accreditation of CDL and issuance of certificates are carried out by licensing and accreditation commissions formed by territorial administrative agencies. Licensing and accreditation commissions and territorial health care management agencies form CDL inspection commissions, manned by representatives of health care agencies, chief territorial laboratory service specialists, and highly qualified specialists in clinical diagnosis. At the suggestion of a laboratory, independent experts may be included in a commission with voice but no vote. A document (Appendix 4) is written up according to the results of the CDL inspection, and on its basis the licensing-accreditation commission issues a certificate (Appendix 5).
- 1.4. The work on accreditation of CDL of hospitals and polyclinics under republic jurisdiction, clinics of medical and research institutes, including the Russian Academy of Medical Sciences, institutes for advanced training of physicians, and institutes of forensic medicine is performed by the Russian licensing-accreditation commission, formed by the Russian Ministry of Health in accordance with Order No 148, dated 28 June 1993, of the RF Ministry of Health.
- 1.5. Accreditation of CDL must precede or be carried out simultaneously with accreditation of MPI, of which the CDL is a part.
- 1.6. A CDL may be accredited regardless of the results of accreditation of the MPI, and a certificate is issued to the CDL (Appendix 5).

- 1.7. Consultation and methodological work on CDL accreditation is performed by territorial commissions for licensing and accreditation, Research Center for Clinical Laboratory Diagnosis of the RF Ministry of Health at the Moscow Medical Academy imeni I. M. Sechenov. Organizational management is implemented by the Administration for Medical Care of the People, RF Ministry of Health and management of territorial health care agencies.
- 1.8. Accreditation certificates are valid for no more than 5 years.
- 1.9. Health care management agencies organize regular inspection of performance of accredited CDL.
- 1.10. Payment for work of CDL accreditation commissions is made at the expense of MPI in which the clinical diagnostic laboratory operates.
- 1.11. If there is disagreement of CDL with the decision of the licensing and accreditation commission it has the right to file a complaint against this decision with the accreditation arbitration commission on the appropriate territorial level.
2. Criteria for accreditation of CDL for forms of work for which application is submitted.
- 2.1. Existence and conformity of CDL working conditions to requirements established by standards and specifications documentation (SSD). SSD include orders of the RF Ministry of Health and territorial agencies of health care management, state and industrial standards, methodological directions and instructions on use of unified clinical laboratory test methods approved by the USSR or RF Ministry of Health, pharmacopoeia items; manufacturer's certificate, technical description and instructions on operation of instruments and use of sets of reagents.
- 2.2. Availability of sufficient number of sufficiently qualified personnel.
- 2.3. Conformity of facilities and CDL working conditions to requirements of the State Sanitary Oversight, State Fire Department Oversight, and rules for safety practices.
- 2.4. Availability of equipment, measuring devices, including standard specimens, certified mixtures, ancillary equipment assuring reliable performance of types of work for which application is submitted.
- 2.5. Availability of sets of reagents, calibration and control materials allowed by the RF Ministry of Health for use in the health service, as well as other chemical reagents needed to perform tests in area for which application is submitted.

- 2.6. Availability at each work place of instructions needed to carry out tests and procedures.
- 2.7. Availability at CDL of instructions on safety practices and industrial sanitation.
- 2.8. Performance of analyses and tests in accordance with unified methods of laboratory tests approved by orders of the USSR and RF Ministry of Health, instructions for sets of reagents allowed by the RF Ministry of Health for use at CDL or nonunified methods approved by MPI management.
- 2.9. Availability at CDL of regular intralaboratory quality control of laboratory tests in accordance with orders of the USSR Ministry of Health No 380 dated 16 April 1975 "On status and prospects of development of clinical diagnostic laboratory service in the nation," and No 545 dated 23 April 1985 "On further improvement of quality control of clinical laboratory tests."
- 2.10. Participation in external (interlaboratory) quality control carried out on the federal and regional levels, presence of a certificate from the agency that implements external quality control.
- 2.11. Presence of statute on CDL and job descriptions for each CDL employee.
3. Procedure for CDL accreditation.
  - 3.1. CDL accreditation involves the following stages:
    - 3.1.1. Preparation by CDL of documents in accordance with appendixes (appendices 1-3) of this statute.
    - 3.1.2. Examination and analysis by the licensing and accreditation commission and by the CDL inspection commission of documents submitted by CDL.
    - 3.1.3. Inspection of CDL by inspection commission.
    - 3.1.4. Preparation and issuance by inspection committee of a CDL inspection certificate (Appendix 4).
    - 3.1.5. Preparation, registration and issuance of certificate by the licensing and accreditation commission (Appendix 5).
4. Rights and duties of an accredited CDL.
  - 4.1. An accredited laboratory has the right, within the limits stipulated in the accreditation certificate to:—carry out the types of laboratory tests indicated in the certificate;—refer to CDL accreditation in documents furnished and advertisement;—set its own prices for analytical tests and services in the accredited area of work;—conclude agreements with other laboratories and MPI to perform specific tests;—in the event of disagreement with the decision of the licensing and accreditation commission,

to lodge an objection following established procedure (RF Ministry of Health Order No 93 dated 20 March 1992 "On steps to implement the law of the Russian Federation 'On health insurance'").

- 4.2. An accredited CDL must:—constantly maintain conformity to accreditation criteria;—make itself available for inspection of laboratory performance;—submit application for accreditation 3 months prior to expiration of current accreditation;—not use the rights of an accredited CDL if the accreditation certificate has expired.
5. A laboratory applying for accreditation prepares and submits the following documents to the licensing and accreditation commission:
  - 5.1. Application (Appendix 1).
  - 5.2. Copy of order or lease on premises (for independent CDL).
  - 5.3. Copies of certificates and licenses issued previously.—Note: A document and certificate of laboratory certification are additionally submitted by laboratories certified in accordance with USSR Ministry of Health Order No 285 dated 16 July 1990 "On enacting RD 42-19-301-90 'Methodological instructions on certification of clinical diagnostic laboratories.'"
  - 5.4. Certificate [descriptive document] of accredited laboratory (Appendix 2) with indication of:—information data (Form 1 of certificate);—types of laboratory tests performed at time of submitting application (Form 2 of certificate);—number of CDL employees, and their qualifications (Form 3 of certificate);—information about premises and equipment (forms 4, 5, 6 of certificate);—information about labor safety practices (Form 6 of certificate);—information about intra- and inter-laboratory quality control (Form 7 of certificate) and Appendix 3.
  - 5.5. Copies of certificates of employees involved in types of work for which application is submitted.
  - 5.6. Annual report for the last 3 years of CDL operation.
  - 5.7. Conclusion of specialists from the Medtekhnika industrial and trade association concerning the condition of medical equipment.
  - 5.8. Conclusion of State Sanitary Oversight.
  - 5.9. Conclusion of State Fire Department Oversight.
  - 5.10. Conclusion of superior oversight agencies on questions of labor safety practices.
6. The CDL chief is responsible for accuracy and reliability of submitted information.

Izdatelstvo "Meditsina," 1994

### Organization of Specialized Emergency Medical Assistance at N. N. Budenko Main Military Clinical Hospital

957A0145A Moscow VOYENNO-MEDITSINSKIY ZHURNAL in Russian No 10, Oct 94 pp 7-12

[Article by V.M. Klyuzhev, general-major of medical service, N.L. Krylov, docent, general-major of medical service, and A.S. Ivlev, colonel of medical service; UDC 616-083.98:[614.2:725.511:355(470-25)]]

[FBIS Translated Text] Emergency assistance is defined as a special form of medical aid given to patients in case of sudden life-threatening illnesses or sharp deterioration of the state of health. Specialized emergency medical assistance is a higher form of medical aid that is provided by highly skilled physicians in treatment facilities (units) specially designed for the purpose with the use of modern medical apparatus, instruments and other equipment.

At N. N. Budenko Main Military Clinical Hospital, specialized medical assistance began to develop with greatest intensity in the eighties. In addition to the long existing ophthalmological, ORL, trauma, neurosurgical, dermatological-venereological and other units, the following units have begun to operate: intensive care and resuscitation (7), cardiac (6), urological (4), neurological (2), pulmonary (2), gastroenteritic ((3), vascular, cardio-surgical, thoracic, hematological, nephrological and endocrinological.

At the present time, the hospital is operating under conditions of constant readiness for doing urgent diagnostic and emergency treatment procedures, which necessitates maintaining professional training of the medical staff and intermediate medical personnel on an up-to-date level, and

logistic support of diagnostic and treatment units with all necessary materials and equipment.

The organization of emergency medical assistance is based on the following principles:

- providing specialized medical aid with minimum delay to all incoming patients and victims, as well as to patients under treatment;
- continuity in providing assistance on prehospitalization and hospitalization stages, as the interaction between hospital and outpatient institutions plays a crucial role in success when treating the most serious contingent of patients;
- profile hospitalization based on syndrome assessment of the patient's condition and analysis of results of laboratory express diagnosis, x-ray and other special methods of examination.

These principles constitute a unified tactic of operations that is mandatory for all specialists when admitting patients, diagnosing and treating acute illnesses of diverse origins.

Specialized emergency medical assistance is provided by on-duty teams of doctors and nurses on a 24-hour basis, starting with the receiving department, followed by diagnostic and treatment procedures in intensive care and resuscitation units or specialized inpatient units. Each team is comprised of three specialists and works under the supervision of a senior on-duty physician. Moreover, urgent medical care is provided to all hospitalized and incoming patients. During the night in case of emergency an appropriate specialist is on call who is not part of the on-duty team. There is a total of 18 physicians on duty throughout the hospital. Figure 1 shows a diagram of organization of the 24-hour roster.

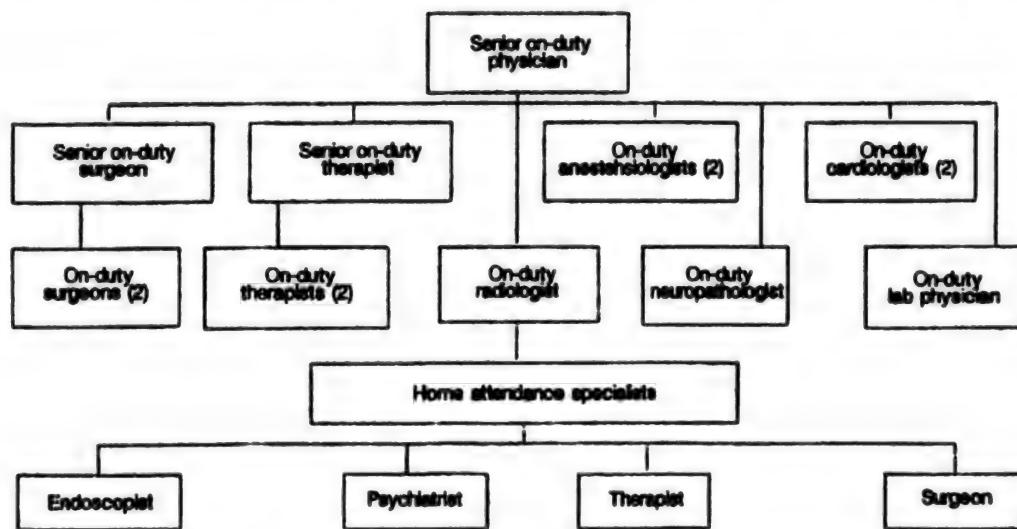


Figure 1. Diagram of organization of 24-hour roster of physicians

With every passing year, there is an increasing number of patients, especially of the therapeutic profile, who are in need of emergency procedures. For example, hospital admissions were 17,997 in 1991, 17,839 in 1992 and 17,854 in 1993, of which the emergency indices were 7,460 (41.5%), 7,612 (42.7%) and 7,618 (42.7%) respectively. Of those, the number of patients of surgical profile was 2,894 (16.1%), 2,956 (16.6%) and 2,908 (16.3%), and the number of therapeutic profile was 4,566 (25.4%), 4,656 (26.1%) and 4,710 (26.4%) respectively. This ratio is due to the large number of cardiac patients and those with acute disorders of cerebral circulation, hypertensive crises, acute illnesses of the digestive and respiratory organs, infectious diseases, diseases of the urogenital system, eyes, ORL organs, maxillary-facial region, traumas, and so on. In recent years, the hospital has begun seeing more and more people of middle and advanced age (as many as 35-40%) in whom the state of health and incipient geriatric pathology frequently lead to sudden onset of pathological conditions that require specialized emergency medical assistance.

Of the total number of patients needing emergency care who were hospitalized in 1993, municipal first aid and emergency service teams sent 3,132, which is 41.1%, the others being brought in by ambulances from polyclinics of central jurisdiction and military units (Figure 2). A minor percentage were individuals transferred from other hospitals, and two people came for assistance on their own. There were also a few patients who were directed to hospitalization without adequate justification. For example, in 1993 inpatient treatment was refused after necessary medical aid had been given to 298 patients (88 therapeutic and 210 surgical), mainly due to the absence of appropriate indications.

To improve the organization of specialized emergency medical assistance, observance of appropriate profiling and earlier start of examination and treatment, a manual has been written: Instructions to On-Duty Physicians on Admission, Triage, and Emergency Medical Care of Patients Entering the Hospital With Acute Illnesses, Traumas and Poisonings.

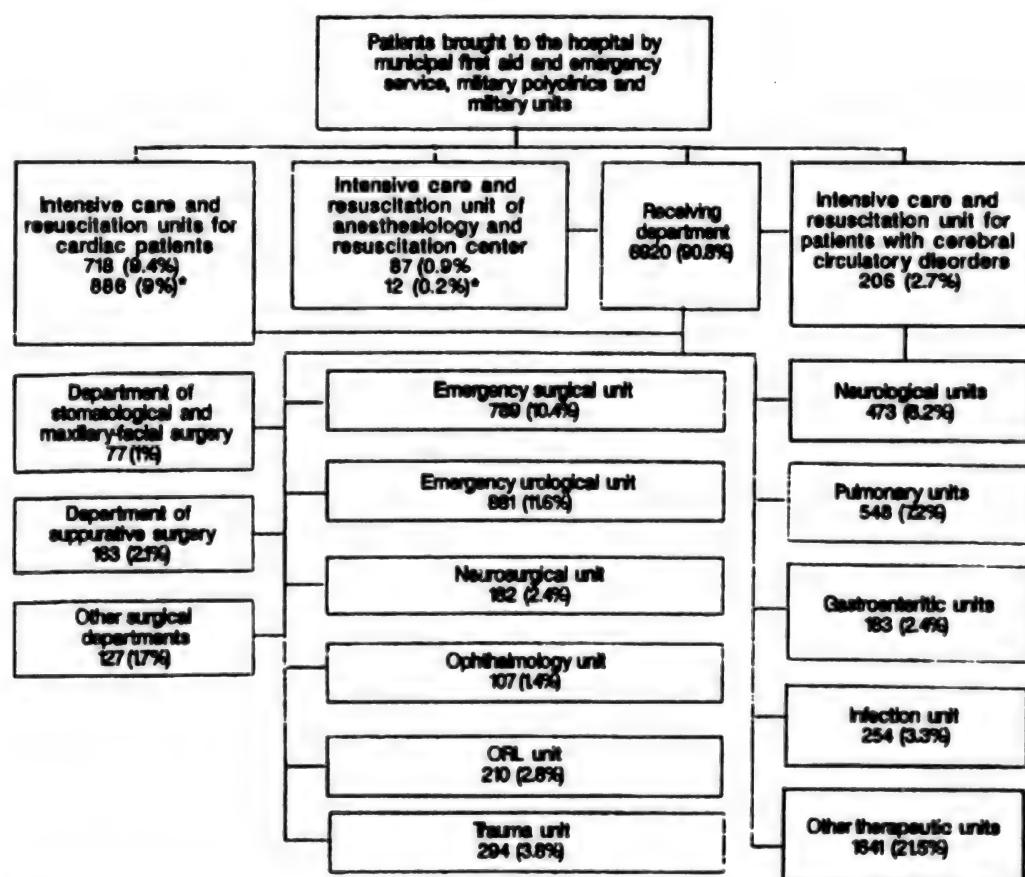


Figure 2. Distribution of patients entering the hospital with respect to emergency indications in 1993. \*Number of patients bypassing the receiving department upon entering the hospital!

In the receiving department, clinical diagnosis is set up with differentiation of leading syndromes requiring emergency medical treatment procedures. Cases that are unclear and complicated from the standpoint of

treatment and diagnosis are discussed with on-duty consultants (surgeon, therapist, neuropathologist, and so on). An average of 8-10% of patients receive emergency medical assistance here.

**Table 1. Diagnostic Examinations Done in Receiving Department of Hospital in 1991-1993, absolute number**

Examinations	Years		
	1991	1992	1993
Radiographic	6321	17705	10325
Sonograms of various organs	195	637	1890
EKG	3615	3991	3769
Laboratory:	8010	11040	12142
leucocyte count	1596	2134	2653
urinalysis	861	1200	1484
blood sugar	815	810	898
hemoglobin level and hematocrit value	3842	4030	4125
blood group and Rh factor	230	196	326
miscellaneous	666	2666	2656
Spinal tap	16	15	15

Table 1 lists the diagnostic examinations done in the receiving department in 1991-1993. In the structure of these examinations, more than 50% pertain to patients of surgical profile, priority being given to radiography and sonograms, leucocyte count, and determination of hemoglobin level and hematocrit value. Among therapeutic patients, first place went to EKGs, biochemical analyses and urinalysis. The main treatment procedures in

surgical pathology were primary surgical treatment of wounds, catheterization of the urinary bladder, and IV drip, and in therapeutic pathology—drawing blood, stomach irrigation, and the like (Table 2). On the whole, the volume of diagnostic examinations and treatment procedures done in the receiving department with respect to emergency indications corresponds to the structure of illnesses.

**Table 2. List of Procedures Done in Receiving Department of Hospital in 1991-1993, absolute number**

Procedures	Years		
	1991	1992	1993
Primary surgical treatment of wounds	123	132	148
Opening abscesses, phlegmons	39	41	58
Catheterization of urinary bladder	65	71	75
Stomach irrigation	7	8	25
Drawing blood	261	308	321
IV drip	110	119	250
Application of slings	69	81	94
Puncture of joints	4	3	12

Considerable significance is given to specialized diagnosis of acute illnesses and emergency states. The requirements of such diagnosis are high, which minimizes the diagnostic period for the purpose of working out the optimum treatment tactic. Predominant among emergency examinations (a special list has been developed for this) done in 1991, were laboratory (84.5%), radiographic (5.3%), endoscopic (5.2%) and functional (4.4%) examinations. Laboratory examinations are done by two express diagnosis laboratories: one does them in

the receiving and therapeutic departments, and the other—in the anesthesiology and resuscitation center, as well as in the surgical units.

The fraction of these examinations in 1991 was 9.7%, in 1992—10.9% and in 1993—12.5. The load of the specialists in express diagnosis laboratories is uneven during the course of the day. For example, during daylight hours, 40% of these examinations are done in the receiving department, and 58% are done in the anesthesiology and resuscitation center (42% during the

evening and at night). The equipment and skill of laboratory specialists enable clinicians to perform timely diagnosis of illnesses and traumas on incoming patients, as well as laboratory follow-up of intensive treatment methods: hemosorption, plasmapheresis, hemodialysis, grafts of organs and tissues, and so on.

Emergency radiation diagnosis is done on a 24-hour basis in the regular x-ray room of the receiving department, where a radiologist and x-ray lab technicians are continuously on duty. Specialists on angiographic and sonographic diagnosis and computer-aided tomography are on call. In 1993 alone, 1,172 examinations were done during the nighttime hours, of which 935 (29.8%) were radiographic, 104 (8.8%) were sonographic, 82 (7%) were done by computer-aided tomography, 43 (3.7%) were angiograms and 8 (0.7%) were done by magnetic resonance tomography. The techniques most frequently used on urgent patients are radiography and radioscopy, followed by sonograms and computer-aided tomography of organs of the thoracic and abdominal cavities, the extremities, the brain and spinal cord, angiographic endovascular manipulations (insertion of caval filters and catheters in intra-arterial infusion therapy).

Functional diagnosis is done by specialists of the center of functional-diagnostic examinations with extensive enlistment of on-duty physicians and intermediate medical workers trained for doing this work. An average of 22.6% of functional examinations are done with respect to extreme indications.

Basically, the inpatient departments are equipped with modern electrocardiographs, and the intensive care and resuscitation departments for cardiac patients are

equipped with Sirekust monitor systems. Esophageal cardiostimulation is used when necessary to diagnose and treat arrhythmias. In 1993, 811 such examinations were done, as well as 1,122 echocardiograms to ascertain acute aneurysm and rupture of the heart, pericardial exudation, exfoliating aneurysm, and so on. Esophageal echocardiography was used on 11 patients.

The investigation of central and peripheral hemodynamics is done by a rheograph and rheographic system only during daytime hours at the base of the functional-diagnostic examination center. The function of external respiration is studied directly in the pulmonary units, and in the appropriate laboratory in cases where it is necessary to determine the degree of a disorder and certain other parameters.

During working hours, urgent endoscopy is done by endoscopic teams, and during off-hours—by endoscopist physicians on call. The number of endoscopic examinations is continually increasing. For example, 92 laparoscopies were done in 1991 on emergency indications, and 319 in 1993 (about 50% of the total number). In 1991, 382 panendoscopies were done for the purpose of topic diagnosis of hemorrhage, and 1,332 were done in 1993. Usually 80% of patients are examined in the first four hours from admission to the hospital, and 100% in the first 24 hours.

More than 81% of endoscopies have been done on the gastrointestinal tract. Of 1,220 patients examined by reason of hemorrhage, cancer was found in 62 (5.1%), polyps in 5 (0.4%), stomach and duodenal ulcers in 552 (45.5%), distended esophageal veins in 18 (1.5%), Mallory-Weiss syndrome, etc. in 56 (5%). Thus, the most frequent cause of hemorrhaging is stomach and duodenal ulcer.

**Table 3. Number of Surgical Patients Entering the Hospital With Emergency Indications in 1991-1993**

Emergency condition	Years		
	1991	1992	1993
Traumas, including cranial and brain	453/2.5	451/2.5	476/2.6
Acute pathology of organs of the abdominal cavity	786/4.4	788/4.4	789/4.5
Acute suppurative illnesses	211/1.2	171/1.0	163/0.9
Illnesses of the kidneys and urinary passages	877/4.9	878/4.9	881/4.9
Acute illnesses of ORL organs	241/1.4	249/1.4	210/1.2
Acute illnesses of the eye	115/0.6	105/0.6	107/0.6
Thrombi and embolisms	61/0.3	89/0.5	76/0.4
Miscellaneous	150/0.8	225/1.3	206/1.2
Total	2,894/16.1	2,956/16.6	2,908/16.3

Note: Data given in absolute numbers in the numerator and in percentage in the denominator

On average, 16.3% of the total number of patients are hospitalized in surgical units for emergency indications (Table 3), mainly in the emergency surgical unit (74%) and the emergency urology unit (4.9%).

In recent years, there has been no significant change in the number of emergency operations. In 1993, 1,235 were done (20.5% of all interventions). Surgical activity

was 60.9% (71% in the emergency surgical unit, 63.6% in the suppurative surgical unit, 8.7% in the neurosurgical unit, 34.7% in the emergency urology unit, 21.4% in the department of stomatological and maxillary-facial surgery, 4.9% and 13.9% in the ophthalmology and ORL units, and 11% in the trauma unit). There was an increase by 0.8% in the number of complex operations.

The structure of emergency surgical interventions is dominated by operations on organs of the abdominal cavity, including on the pancreas, bile ducts and cholecystectomies (27%), appendectomies (25%), operations with complex ulcer of the stomach and duodenum (10%), acute

intestinal blockage (6%), diseases of the large and small intestines (5%), miscellaneous (27%). In second place are operations for suppurative illnesses (peritonitis, pleural empyema, abscesses), and in third place—interventions for emergency urological illnesses.

**Number of Therapeutic Patients Entering the Hospital With Emergency Indications in 1991-1993**

Illnesses, emergency conditions	Years		
Myocardial infarction and other manifestations of coronary insufficiency	2,358/13.1	2,520/14.1	2,536/14.2
Hypertensive crises	308/1.7	301/1.7	304/1.7
Acute pneumonia, bronchial asthma	598/3.3	536/3.0	548/3.1
Acute liver failure, exacerbation of chronic kidney failure	26/0.1	23/0.1	17/0.1
Acute disorders of cerebral blood circulation	512/2.9	518/2.9	517/2.9
Miscellaneous	764/4.3	758/4.3	788/4.4
Total	4,566/25.4	4,656/26.1	4,710/26.4

Note: Same as in Table 3

There has been a steady increase in the number of therapeutic patients with emergency pathology. The fraction in 1991 was 25.4%, and in 1993—26.4% (Table 4). Among those hospitalized, most have been persons suffering from cardiovascular illnesses (80%) and bronchopulmonary illnesses (12%).

Emergency assistance for cardiovascular illnesses is provided in two intensive care and resuscitation units that are part of the cardiac center of the hospital. One of these is intended for patients with acute transmural myocardial infarction, and the other—for patients with unstable stenocardia, focal myocardial infarction, and other forms of CHD, those with illnesses complicated by acute heart failure or severe decompensation of chronic circulatory insufficiency, disorders of cardiac rhythm and conduction, and also for patients with thromboembolism of the pulmonary artery needing thrombolytic therapy. The units are provided with monitor systems and resuscitation equipment, and are located on the same floor with rooms for angiography, radionuclide diagnosis and echocardiography.

Each year, these units handle treatment of 500-600 patients with myocardial infarction, 850-1,014 with CHD, and 170-200 with other illnesses. In the general structure of those treated, they amount to 40%, 50% and 10% respectively. On average each year there are more than 150 laboratory studies per patient here. Physicians of the units do such diagnostic-treatment manipulations as catheterization of central veins (300-400 patients), electrocardiographic examination (700-800), esophageal cardiostimulation for diagnosis and treatment (110-125), temporary endocardial stimulation (20-30), cardioversion (23-30) and the like.

Patients with myocardial infarction admitted within 6 hours after the start of the illness, assuming no contraindications, are given thrombolytic therapy (50-70 per

year). For 90% of patients, treatment involves using nitroglycerin (intravenously), heparin, for 30%—calcium antagonists, beta-blockers, disaggregants, and for 20%—angiotensin inhibitors. Lethality in the case of MI in the acute period for the last 3 years has not exceeded 7-8%.

In the case of unstable stenocardia, extensive use is also made of nitrates, heparin and disaggregants. Moreover, intracoronary and systemic administration of fibrinolytic agents is prescribed for some patients. The frequency of development of myocardial infarction with this pathology declined from 12% in 1987 to 6% in 1992.

The efficacy of treatment of emphysema in CHD patients is nearly 90%. The complex of treatment procedures in this combination includes isolated ultrafiltration.

It should be noted that in recent years, among those entering the hospital for emergency indications there has been a considerable increase in the number of people who have not received adequate supporting therapy at home due to the lack of necessary medicines in pharmacies.

A large number of patients needing emergency assistance have been sent to the pulmonary units—11% of all therapeutic patients. Every year in these units, as many as 250 bronchoscopies are done by reason of urgent indications (hemoptysis, pulmonary hemorrhaging, atelectases, and so on).

In 1993, 680 people (70% of all neurological patients) were admitted to the neurological units with emergency conditions, of which 517 had acute disorders of cerebral blood circulation (among the latter, 55% had pretreatment in the intensive care and resuscitation unit for patients with cerebral circulatory disorders). It should be noted that there has been an increase from 29% in 1992 to 40% in 1993 in the number of people admitted by reason of emergency indications in connection with diseases of the peripheral nervous system. In November

of 1993 the hospital organized 24-hour duty for a neuropathologist charged with the responsibility of carrying out emergency procedures during nighttime hours in case of necessity. For diagnostic purposes, active use is made of computer-aided tomography of the brain, selective angiography, sonograms and other methods of examination.

The cited data reflect the current state of organization of specialized emergency medical assistance at N. N. Budenko Main Military Clinical Hospital. There is a lot to be done in the immediate future to upgrade this service, especially in the area of closer interaction between hospital specialists and physicians of central polyclinics, first aid and emergency medical assistance in other institutions of the prehospital stage.

### Using Mafusol in Acute Loss of Blood

957A0145B Moscow VOYENNO-MEDITSINSKIY ZHURNAL in Russian No 10, Oct 94 pp 33-34

[Article by M.I. Rudenko, colonel, medical supply service, V.N. Andryushkin, lieutenant colonel, medical service, and V.G. Artemov, senior lieutenant, medical service; UDC 616-005.1-036.11-02:616-001+616-089]-085.2 Mafusol]

[FBIS Translated Text] The acute massive loss of blood that accompanies a traumatic shock or surgical operation leads to disruption of tissue perfusion, development of hypovolemia (anemia) and hypoxemia. Making up the loss with blood preparations does not eliminate acidemia, and besides, these infusions are not utilized by cellular energy systems in pronounced hypoxia. Acid metabolites, accumulating in the blood, increase the deficit of buffer bases. To correct acute hypovolemia, we have included mafusol as part of the infusion-transfusion therapy. This is a crystalloid solution that contains sodium fumarate, which has antihypoxic bioenergetic directivity.

The preparation has been used in treating 50 patients who had undergone lung operations, mainly by reason of malignant growths. The average age of the patients was 56.4 +/- 5.4 years. Diagnostic thoracotomy was done on 3 patients, lobectomy and bilobectomy—on 27, pneumonectomy—on 19, and pleurectomy on 1. All patients had planned operations. Anesthetization was combined: epidural anesthesia with artificial ventilation of the lungs (AVL) and shutting off consciousness by a mixture of nitrous oxide with oxygen, and in the case of one-lung ventilation, consciousness was shut off by drip or bolus administration of ketamine. The average duration of one-lung ventilation was 55 +/- 18 minutes. AVL was done with a gas mixture containing 60-80% oxygen. During the operation and anesthesia, the following were monitored: gas composition of arterial blood, volumetric circulation of oxygen (VCO), central hemodynamics, volume of extracellular fluid (VEF), respiration and electrolyte composition of plasma.

The average weighted blood loss during an operation was 698 +/- 150 ml, and 457 +/- 53 ml of serum was drained from the pleural cavity during the first two days.

In 12 patients, VCO was studied by using  $^{131}\text{I}$ -tagged albumine prior to the operation, 1-2 hours afterward, and on subsequent days. Operation blood loss was made up with moderate doses of mafusol—945 +/- 40 ml, dextran—473 +/- 40 ml, a 10% solution of glucose with potassium, riboflavin and insulin—291 ml, and when necessary erythrocytic mass—418 +/- 30 ml. The slight reduction of VCO following the operation and on subsequent days amounted to 2.7% and 4.1% respectively ( $P > 0.05$ ). However, VEF gradually declined during the operation, and by the end had reached 95.1% of the initial level. Within 24 hours, VEF had increased to 97.6%.

This infusion-transfusion therapy during the course of the operation maintained central hemodynamics within normal limits. The impact and cardiac indices on the stage of thoracotomy were reliably reduced to 39.6 +/- 3.0  $\text{ml}/\text{m}^2$  and 3.3 +/- 0.4  $1/(\text{min} \times \text{m}^2)$  respectively as compared with the initial indicators, which were 62.6 +/- 9.0  $\text{ml}/\text{m}^2$  and 4.9 +/- 0.6  $1/(\text{min} \times \text{m}^2)$ , the heart rate increased from 80.1 +/- 5 to 80.3 +/- 5 beats per minute. These shifts in central hemodynamics are apparently due more to regional neurovegetative blockade arising at the height of the epidural block than to changes in VCO. The average dynamic arterial pressure and total peripheral resistance (TPR) of vessels in the course of the operation increased from 80.3 +/- 10.7 to 101.7 +/- 8.9 mm Hg and from 994 +/- 100 to 1,369 +/- 120 dynes/( $\text{s} \times \text{cm}^{-5}$ ) respectively, but by the end of the operation these indices did not differ from the initial values. The work index of the left ventricle gradually decreased from 13.3 +/- 1.2 to 10.7 +/- 1.5 kgm/min ( $P < 0.05$ ) which, in our opinion, is due to improvement of the rheological properties of blood, absence of hypoxia in the arterial blood, and also to the qualitative and quantitative make-up of VCO during the operation. This is confirmed by the reduction of hematocrit value from 40.2 +/- 1.2 to 31.0 +/- 2.0%.

During conduct of one-lung ventilation, when the most pronounced shifts are observed in the gas composition of blood and metabolic indicators, pH is 7.37,  $\text{pO}_2$ —118 +/- 38 mm Hg,  $\text{pCO}_2$ —43.5 +/- 5.4 mm Hg and  $\text{VC}$ —0.2 +/- 1.7 mmole/l.

Thus, the inclusion of mafusol in infusion-transfusion therapy can correct the acidotic shift. The  $\text{VC}$  deficit by the sixtieth minute with one-lung AVL was only 1 mmole/l as compared with the initial capacity, and by the end of the operation the  $\text{VC}$  excess was 2.5 +/- 0.6 mmole/l. The gas composition of the arterial blood for the same conditions of ventilation remained stable over the course of the entire operation. Results of studies of bilirubin, AsT, ALT, alkaline phosphatase, electrolytes and resuscitation of plasma in the course of mafusol transfusion showed absence of hypoxic injuries of organs.

Operations of this kind in the case of tumorous lung diseases under epidural anesthesia with one-lung AVL but without using mafusol were done on 44 patients (average age 57 +/- 3 years). The gas composition and acid-base state of the lungs were studied in these patients. With one-lung ventilation, by the twentieth minute  $pO_2$  had decreased by 33%, forcing conversion to 100% inhalation of  $O_2$  and correction for hypercapnia. There was a statistically reliable increase in VC deficit by the twentieth minute from 1.6 +/- 0.2 to 3.1 +/- 0.9 mmole/l, which continued to be exacerbated during the course of the operation. Thus, thoracic operations with one-lung ventilation lead to mixed acidosis and hypoxemia.

Our studies have shown that mafusol reliably prevents development of metabolic acidosis, and in the process helps to achieve an antihypoxic effect, which could make it the agent of choice when treating acute loss of blood and traumatic shock on the very earliest stages of providing medical assistance.

When providing skilled and specialized surgical assistance, mafusol should be included on a par with plasma-substituting solutions of hemodynamic action in the infusion-transfusion program of treatment of acute operational blood loss and subsequent treatment of the acute period of post-traumatic illness.

#### **Pathomorphological Aspect of Modern Explosion Trauma**

*957A0145C Moscow VOYENNO-MEDITINSKII ZHURNAL* in Russian No 10, Oct 94 pp 38-46

[Survey article by K.K. Zaytseva, doctor of medical sciences, M.A. Velichko, colonel of medical service, and V.A. Nechitaylo, docent, colonel of medical service, ret.; UDC 626-001.45-091(048.8)]

[FBIS Translated Text] At the present time, the weaponry of many nations includes shaped-charge and plastic mines, toy mines, mines with diverse standard wounding elements, explosive devices with contact, remote-control, magnetic and biocontact mechanisms. Severe traumas are caused not only by mine shrapnel, but also by the powerful explosive wave, as well as by secondary wounding projectiles—rocks and the like. The action of the flame (high-temperature zone) produced in an explosion results in deep burns. The severity of the condition of the wounded is often exacerbated by contusions of the brain, lungs, heart and kidneys, hemorrhages into serosa and mucosa.

The war in Afghanistan, in which Soviet troops (the 40th army) participated on the side of our nation's government, could rightly be called a mine war, as there had never before in the history of war been such massive use, and most importantly, such effective use of engineering mine munitions. In 1980, the number of victims of mine weapons in the army of the Republic of Afghanistan did not exceed 3%, in 1982 it was 20%, and during the height of the war (1984-1987), this index rose to 30-40%, the

aggregate non-battle casualties in those years from munitions of explosive action ranging from 75 to 85% [17].

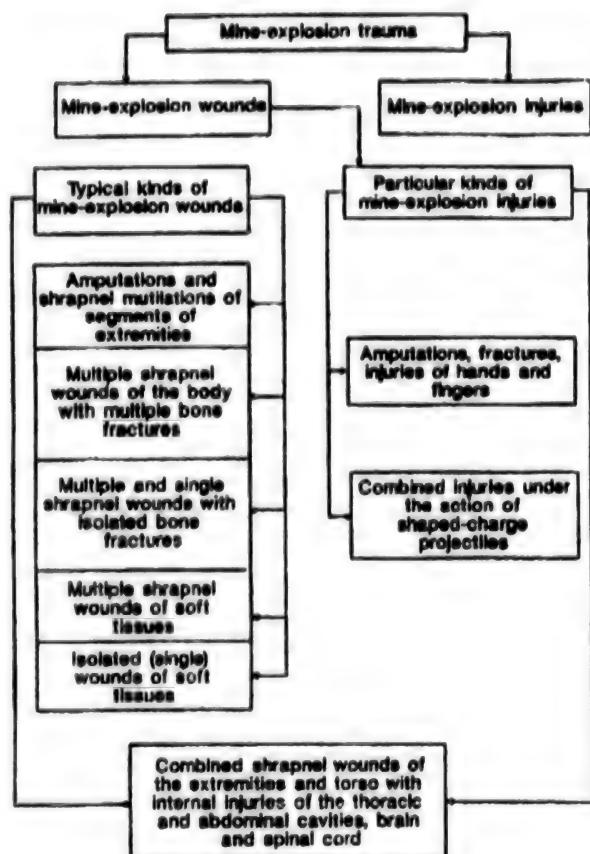
The multifactor conditionality and diversity of today's explosion trauma, in which pathological processes in the organism of victims develop on every level of morphological organization (molecular, subcellular, cellular, tissue, organ, systemic, organismic), have faced not only surgeons, trauma and resuscitation specialists, therapists and other specialists, but also military pathologist-anatomists with some complicated and crucial problems. This relates primarily to the study of pathomorphology of modern battle injuries, the causes and mechanisms of onset of death (thanatogenesis) with different localizations and forms of battle trauma, scientific generalization of morphological data, analysis of defects and their causes ascertained from the results of providing medical assistance, and participation in development of procedures for eliminating and preventing them.

The solution of these problems to a great extent determines the tactics of military physicians in diagnosing explosion trauma, and consequently treatment of the wounded on stages of medical evacuation. Based on the foregoing, the operations of military pathologist-anatomists should be considered an essential component of the system of medical support of victims, and should play a key role in the solution of basic problems of pathology of today's battle trauma. Unfortunately, its morphological aspects have been treated in only a small fraction of scientific publications based on analyzing materials of the war in Afghanistan. We have attempted to fill this gap in some measure by generalizing facts available in the literature. Our main thrust has been on the explosion trauma that has predominated in battle operations in this region.

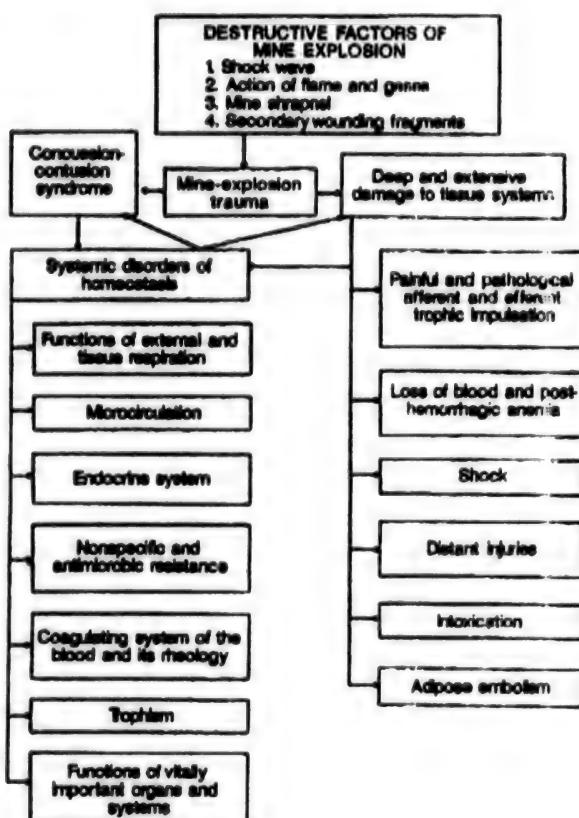
From the etiopathogenic and tactical treatment viewpoints, two varieties of mine explosion trauma (MET) are distinguished: mine-explosion wounds (MEW) originating mainly as a result of the contact strike mechanism acting on unshielded personnel, and mine-explosion injuries (MEI) in consequence of a strike on personnel in a combat vehicle (Figure 1).

There are many contradictions concerning terms used in combat surgical pathology. Different concepts are often used for the same states, and different kinds of combat pathology are denoted by the same term. Different interpretations persist for such concepts as "firearm trauma," "firearm injury," "firearm projectile," "wounding projectile," "trauma," "injury" and "traumatic infirmity." In this context, we have taken our lead from the works of S. S. Tkachenko [20, 21], I. A. Veryukhin and Ye. K. Gumanenko [11], E. A. Nechayev, A. I. Gritsanov and N. F. Fomin [16], in which we feel that the most rational terminology is used for combat surgical trauma, satisfying clinical-morphological and medical-tactical classification attributes.

The investigation and generalization of operational and sectional materials, as well as results of experimental



**Figure 1. Classification of mine-explosion trauma  
(according to A. I. Gritsanov et al., 1988)**



**Figure 2. Pathogenesis of mine-explosion trauma  
(according to E. A. Nechayev et al., 1991)**

research on modeling of explosion injuries have shown that in the pathogenesis of MET (Figure 2) that originates with impulse action of a set of injuring factors (air shock wave, jets of explosive gases, fragments, high flame temperature, gas detonation products), one can clearly trace two interdependent and mutually aggravating trigger mechanisms of compensatory and pathological reactions that are equally responsible both for development of systemic disruptions of homeostasis, and for the specifics of traumatic infirmity [17].

On the one hand there are the deep and extensive injuries of tissue structures (primarily muscle masses and bones of the extremities) that are a source of blood loss, painful and pathological trophic impulsion, and that result in shock, adipose embolism, and stable endogenous intoxication of the organism initially due to discharge of a large amount of myoglobin into the bloodstream. On the other hand, there is the general concussion-contusion syndrome that is clinically manifested by symptoms of cranial-cerebral trauma and morphofunctional disorders in the lungs, heart, kidneys, and organs of the gastrointestinal tract [2, 5, 6, 13, 26, 27]. In this regard, we have deemed it advisable to concentrate attention on

pathomorphological shifts in tissues in the case of mine-explosion severing of extremities, pathology of internal organs in MET, and characteristics of lethal outcomes for a given category of victims.

**Pathological changes in tissues in the case of mine-explosion severing of extremities.** A morphological study of segments of lower extremities amputated in the first 12-15 hours after trauma, and biopsy material taken from the edges of the wound of amputation stumps after 2, 3, 7, 10 and 14 days showed exceptional severity and extent of structural disruptions going beyond the limits of the severed segments, and also extremely great diversity of the surgical anatomy of wounds [10, 18, 23, 25]. Differences pertain to the level of detachment of extremities and severity of pathomorphological disorders. The polymorphism of exposed injuries can be attributed not only to the diversity of the munitions of explosive action that are used, but also to differences in the position of the victim's body with respect to the mine device at the instant of explosion.

All injuries that occur in an extremity damaged as a result of explosion are conventionally divided into three

topographic-anatomical zones (levels) differing in qualitative structural characteristics: the first is the zone of detachment; the second is the zone of contusion of tissues of the retained part of the damaged segment; and the third is the zone of commotion of tissues of the adjacent segment of the extremity [25].

Changes in the *first zone* reduce to tearing or total destruction of anatomical structures of the extremity by a traction mechanism combined with contusion and smashing of tissues. Because of the uneven mechanical strength of different tissues, their damage occurs on different levels: skin, bones, tendons, major vessels and nerves—more distally; subcutaneous adipose cellular tissue, muscles, connective tissue—proximally. Also typical is ascending pneumatization of the subcutaneous adipose tissue and slack connective structures. Considerable soiling of the wound surface is noted, as well as deep impregnation of tissues with explosion products. A microscopic study shows complete disintegration of cellular structures, breaks, retraction and coagulative necrosis of tissues, and thrombosis of vessels. Necrotic changes occur mainly in muscle tissue. In the immediate hours following the explosion, damaged vessels are patent, and therefore external hemorrhaging is possible. Shock waves (of compression and deformation) and ultrahigh pressure of jets of incandescent explosive gases play a major role in the genesis of tissue damage.

Morphological changes in the *second zone* are based on multiple focal microruptures of the muscles and walls of major and minor blood vessels, resulting in overflow and focal hemorrhaging. Vessel walls show focal hemorrhaging, desquamation of the endothelium, and destructive changes in membranes, which is conducive to formation of obturating thrombi. Some sections show traumatic breaks of vessel walls at a considerable distance (2-4 cm) from the point of direct action of the traumatizing agent [4, 23]. The peripheral nerves show endoneurial and epineurial hemorrhaging, edema of cellular tissue, endo- and perineuria. Venous plethora, acute dystrophy of muscular tissue, and reactive changes in the axons of peripheral nerves indicate secondary disruptions of regional blood circulation. These disorders are focal in nature, their depth and extent decreasing with increasing distance from the zone of tissue tearing.

Maximum destruction is localized in the main vascular-nerve bundles of the retained part of the segment of the extremity. At the same time, throughout the second zone there are sections of intact tissues, the proportion of which increases in the proximal direction of the extremity. In the practical respect, it is important that the upper limit of the contusion is not the line of the joint gap of the closest retained joint, but the anatomical limit of the muscle sheaths. The muscles of the higher segment of the extremity are shielded as it were by their own fibrous sheaths within the limits of the contused tissues of the lower segment.

The *third zone* is typified by pronounced disruptions of microcirculation of the blood, chiefly in the fine arteries and veins, reactive shifts in axons of individual peripheral nerves, and focal granular dystrophy of muscle fibers. These shifts are especially noticeable on sections that are in direct contact with the main vascular-nerve bundle, which shows edema of the paraneurial and paravasal cellular tissue and hemorrhaging in the region of the *vasa vasorum*.

The pattern of morphological changes in biopsy material taken from the stump of an extremity 2 weeks after amputation shows a considerable volume of paraneuritic changes in the wound, and delay of all phases of the inflammatory process. For the first few days, alternative-exudative shifts predominate. On the third day, a zone of necrosis appears that is bounded by a line of demarcation. Leucocytic infiltration propagates through the interfacial space far beyond the limits of the line where the bone has been sawn off. Muscle fibers are on various stages of necrosis and dystrophy. The sarcoplasm in mortified muscles by this time begins to be resorbed, the sarcolemma is still retained.

By the end of the first week, granulation tissue begins to form, and by the 10th-14th day, signs of its maturation appear. Necrotized tissues are torn away, and dystrophic changes increase in the muscle fibers, causing them to die and atrophy. Blood vessels show effects of panvacuolite and wasting of individual sections, and thrombi are formed. Peripheral nerves are typified by growth of endo- and perineurial connective tissue, and formation of traumatic neuromas.

Experiments on dogs with simulation of mine-explosion wounds like those in humans likewise showed sharp zonality of the distribution of vascular damage in segments of the extremities both with respect to severity and with respect to the nature of pathomorphological and functional disturbances [23, 24]. The structural-functional vascular disorders that arise considerably change the natural topography of blood flow at an appreciable distance from the point of tearing of tissues as a result of explosion. Under these conditions, upon restoration of tissue blood circulation in the near-wound space there is an increase in the role of collateral connections between vessels of moderate and small size.

Among the most severely injured, deep neuromorphological disturbances may develop on general and regional levels. They were revealed in multiple-plan histomorphological studies of amputated extremities of the wounded, and confirmed in experiments [7, 9]. It has been established that changes in the sciatic nerve and its branches depend on the level of amputation and time of study. Within limits of 5-10 cm from the point of tearing of the nerve within the first few hours after the wound, breaks are observed in the arteries and veins proper with formation of extensive paraneurial and endoneurial hemorrhaging, and some vessels are thrombosed. After six hours or more after trauma of the shin, gross breaks can

be seen in the integrity of the myelin sheaths of nerve fibers. Toward the end of the first few days, reactive changes are observed in the fleshy nerve fibers, where degenerative processes begin to develop. These phenomena set in only in those sections that continue to be supplied with blood. Primary changes of nerve fibers in direct proximity to the edge of the wound (2-4 cm) seem to congeal, which can be attributed to "ischemic conservation" of structural damage to the peripheral nerves.

Experiments on dogs filled out the details of neuromorphological changes that occur. Among other things, it was established that subsequently developing periaxonal retrograde degeneration covers as many as ½ of fleshy nerve fibers on the shin, and at least 1/4—on the thigh [7, 9].

The results of pathomorphological studies of local and segmental disruptions in tissues in mine-explosion severing of extremities served as a foundation for developing a scheme of pathogenetic treatment of this class of wounds, which was tried in the course of combat operations in Afghanistan. Clinical experience shows that the organ-preserving operations and intensive care enable determination of the advisable level of amputation with the greatest probability for this type of trauma, which is the basis for formation of the strategy and tactics of ensuring the maximally favorable course of a traumatic infirmity and effective treatment of the wounded [24].

**Pathology of internal organs in mine-explosion trauma.** When destructive factors of an explosion act on the organism, the first to develop are primary injuries to the internal organs (contusions, commotions, tearing), that are noted in 96.4% of those admitted due to MET [14]. The greatest number are contusions of the lungs (20.7%) [2, 15]. Macroscopically, the morphology of contusion of the lungs in blows against the rib cage is represented by extensive focal hemorrhaging with formation of infarct-like sections, and tears of the visceral pleura and parenchyma of the lung. In a closed trauma of the chest, focal atelectases and emphysematous sections are determined. Barotrauma of the lungs is typified by foci of emphysema and hemorrhaging, as well as tearing of lung tissue. Extensive hemorrhaging and contusions are often accompanied by traumatic emphysema.

Microscopically, the lungs show extensive foci of hemorrhaging, disruptions of microcirculation of the blood and inflammatory leucocytic infiltration. Disorders of microcirculation lead to thrombosis of small blood vessels and infarction. Numerous foci of post-traumatic inflammation are subsequently resorbed and lung function is restored. In some cases, even with adequate treatment, the foci of inflammation in lung tissue increase, giving a clinical picture of focal pneumonia, and sometimes they form abscesses. Among the specifics of focal pneumonia that develops in contused lung sections (23.7%) is its early occurrence (first or second day after contusion).

In second place in MET are contusions of the heart (14.8%). Their mechanisms, like those of lung contusions, are most often associated with blunt trauma when

the body is thrown against blunt hard objects at the instant of the explosion and contusion of the rib cage. In the heart, a pear-shaped chamber with fluid content, the liquorodynamic shock that arises in MEW is uniformly propagated in all directions [1]. However, because the diameter of the chamber is smaller at the top of the heart, the most abrupt expansion of the outside of the myocardium is observed here, leading to subepicardial hemorrhaging and overstretching of myofibrils. In the base of the heart, changes of the myocardium are less pronounced, but predominant there is gross damage of the intima of major coronary arteries.

In the small blood vessels of the myocardium, the epithelium is peeled from the internal elastic membrane, which is conducive to subendothelial penetration of blood elements and microthrombosis. Pronounced edema of the myocardium is combined with small-focus and overflow hemorrhaging. Foci of necrosis and dystrophic changes of the myocardium arise against this background. The general pattern is exacerbated by edema of the stroma, sometimes with the addition of an inflammatory reaction, which is an indication of the beginning of development of traumatic myocarditis.

When there are contusions of the chest, there is frequently hemorrhaging into the mediastinum, thymus gland, trachea, large bronchi and esophagus, often giving rise to mediastinitis, tracheitis, bronchitis and esophagitis.

Every tenth victim (10.1%) shows signs of contusion of the kidneys with hemorrhaging into paranephric cellular tissue, subcapsular tearing, and hemorrhaging into the cortical material of the kidneys. In the acute period of the trauma, there is a "shock kidney" pattern in the form of a diminution of glomerular capillaries, hyperemia of pyramids with paralytic expansion of blood vessels, and disruption of microcirculation. Later on (3-6 hours or more), there are dystrophic shifts in the epithelium of the convoluted and main tubules, and there is sometimes necrosis of the epithelium.

Contusions of other internal organs of the abdominal cavity and surrounding cellular tissue are encountered much less frequently (intestines and mesenteries—8.3%, liver—4.7%, spleen—4.7%, stomach—2.9%, pancreas—2.5%, adrenal glands—1.2%). Morphologically, hemorrhaging is observed in the anterior abdominal wall, in the parietal and visceral peritoneum, the surrounding cellular tissue, and the membranes of the stomach, intestine and other organs. Hemorrhaging is conducive to dystrophic and necrotic changes in the tissues, subsequently leading to complications: acute ulcers of the stomach and intestine with possible profuse bleeding, perforation and peritonitis, commissural process in the abdominal cavity, blockage, inflammation, and so on.

Tearing of internal organs is observed mainly in MEI as a result of blunt trauma. Most frequently there are tears of the spleen, kidneys and liver. Hemothorax, pneumothorax, hemoperitoneum and hemopericardium occur in the first hours following injury. In the case of

mine-explosion cranial-cerebral trauma, contusions of the brain are noted in 19.3% of victims and are accompanied by subarachnoid hemorrhaging.

Following mine-explosion wounds of the extremities, there is a change in the morphological state of centers of neurohumoral regulation. Hypothalamo-hypophysial neurosecretion and microcirculation are disrupted in these parts of the brain, which cannot but exacerbate the course of traumatic infirmity [9].

MET is also typified by secondary inflammatory-dystrophic changes of internal organs. Pneumonia accounts for 22.5% of secondary changes in the structure of the lungs [26]. It most often sets in 3-4 days following trauma. Its occurrence is preceded by macro- and microatelectases, erythrocytic stases, interstitial edema, microembolism, thrombosis of small branches of the pulmonary artery, micro- and macronecroses. By the third or fourth day, the lungs show massive leucocytic infiltration of the alveolar walls, and the lumina of the alveoli contain serous exudate with an admixture of polymorphonuclears, macrophages and alveolocytes. The frequency of focal pneumonia is 82%, overflow—14.7%, lobar—2.1%, infarct pneumonia—1.2%. Within 4-6 days after MET, abscessing pneumonia and exudative pleuritis may develop. Pathological changes of the respiratory organs in 15.1% of cases lead to development of respiratory distress syndrome or acute respiratory failure, often being a direct cause of death of victims [12, 19].

Secondary changes of heart muscle in persons dying on the first or second day following trauma are represented by disruptions of microcirculation, disintegration of cardiomyocytes, and dystrophic changes of cell cytoplasm. When there are contusions of the heart, there will be focal hemorrhaging, lymphocytic and leucocytic infiltration of connective tissue. Those dying 7-10 days following trauma show fragmentation of muscle fibers, increased stromatal edema, dystrophy of cardiomyocytes, cellular infiltration, and thrombosis of blood vessels.

Comparison of clinical and morphological data allows two basic forms of myocardial injury to be distinguished: myocarditis and myocardiodystrophy. With respect to origin, myocarditis accompanying heart contusions is evaluated as post-traumatic, and with suppurative complications—as toxic. In the pathogenesis of myocardiodystrophy, a fundamental part is played by post-hemorrhagic anemia, stress factors, including surgical interventions, metabolic disturbances, and exogenous infection. Pericarditis develops in 31.2% of cases of severe contusions of the heart.

Pathological changes of the kidneys in explosive injuries accompanied by shock and blood loss are manifested by acute kidney failure or post-traumatic nephropathy. In the first three days there is diminution of glomerular capillaries and paralytic expansion of the small vessels of Malpighian pyramids. Among those dying 7-10 days following trauma, an edematous state of glomerular capillaries is determined with serous exudation into the

capsule of the renal glomerulus (Shumlyanskiy-Bowman), desquamation of the epithelium, dystrophy and necrosis of the epithelium of tubules. Acute kidney failure develops in 8.3% of victims, and as a rule is caused by massive injury of tissues and prolonged hypertension due to bleeding and shock.

Changes of the gastrointestinal tract in the early period after trauma are due to contusions and hemorrhaging into the walls of the stomach and intestines. Inflammatory and necrotic changes, erosions and ulcers occur at the site of bleeding.

Morphological changes of the liver are manifested on the first day by disrupted structure of the organ, granular and hydropic dystrophy of hepatocytes, foci of destruction of the parenchyma, and leucocytic infiltrates. The development of interstitial hepatitis (at first of post-traumatic, and then of toxic origin) may lead to acute liver failure, exacerbating the course of traumatic infirmity.

The pancreas shows edema, dystrophic and autolytic changes in the cells of the islet apparatus, and sometimes acute pancreatitis develops.

Anemia, most often post-hemorrhagic, is a major pathogenetic factor of development of polyorganic dystrophic changes in MEI, and is encountered in 95.9% of the wounded [12].

Recently, more and more weight is being given in MET to neurodystrophic changes in tissues, as it is these changes that are linked to frequent development of severe suppurative complications (as high as 69.3%) among the wounded with mine-explosion severing and crushing of segments of the extremities, necessitating reamputation, and in 17/4%—multiple reamputation [7].

Thus, an in-depth study of MET pathomorphology shows that explosion trauma, as a predominant part of the pathology of combat injuries in Afghanistan, should be classified in the category of combined combat injuries. In its trigger mechanisms, evolution and subsequent course, a considerable part is played by systemic and regional disorders of blood circulation, endogenous intoxication of various origins, and an acute neurodystrophic process in their dialectic unity [2].

**Characteristics of lethal outcomes in mine-explosion trauma.** Depending on the type of combat trauma in 1980-1987, lethal outcomes of bullet wounds were predominant, although their frequency declined considerably (from 69.4% in 1980 to 46.2% in 1985-1987) with a simultaneous increase in the proportion of lethal outcomes from MET from 4.2% to 32.3% respectively. On average over all years of combat operations, those who died from mine-explosion trauma comprised 41.4% of the number who died from firearm wounds. The dramatic increase in percentage of MET in the structure of non-combat casualties has demanded special pathological-anatomic investigation of lethal outcomes ensuing after this trauma.

A study of the frequency of destruction of anatomical regions of the body with respect to a prevailing injury or wound that have served as the main causes of death in MET has shown that victims having combined MEW with predominant detachments of one or both lower extremities have comprised an absolute majority among those dying (38.5%) [8]. Wounds with severe cranial-cerebral trauma, both in MEW and in MEI, took second place (19.6% and 10.4% respectively). In third place were victims with thoracoabdominal wounds and stomach wounds (19.6%).

In most cases (63.7%), death occurred within the first 24 hours following trauma (the toxic reaction period of traumatic infirmity). The immediate and most frequent causes of death in this context were shock and loss of blood (49.1%), destruction of vital organs (28.4%), and adipose embolism (17.2%). In the second (toxemia) and third (toxic infectious) periods, the cause of lethal outcomes was infectious complications on the part of organs of the abdominal cavity (31.3%), brain (16.6%) and lungs (16.2%), acute heart failure (9.1%) and kidney failure (4.5%). The wounded most frequently died from these causes 7-8 days following trauma.

The foregoing is confirmed by data of analysis of 296 cases of lethal outcomes, according to which about 60% of victims died in the early period from the immediate action of explosion factors. The cause of death was mainly destruction of vital organs, blood loss combined with indications of shock, shock proper, air and adipose embolism [3].

Complications among MET victims developed 2-4 days following wounding, and caused death in 36.3% of cases. Most frequent among these were: developed peritonitis (30.3%), pneumonia (18.2%), and meningoencephalitis (16.6%). In contrast to complications observed during World War II, gas gangrene occurred in only 4.5% of the wounded.

M. V. Rogachev and I. V. Timofeyev [19] obtained essentially similar results in a study of 464 cases of lethal outcomes of explosion trauma, among which 129 (27.8 +/- 2.1%) died on the battlefield, and 335 (72.2 +/- 2.1%)—in military treatment facilities. Leading Among immediate causes of death were primary loss of blood (20.0 +/- 1.9%), destruction of vital organs (12.1 +/- 1.6%), brain contusion (11.2 +/- 1.5%), pneumonia (10.1 +/- 1.4%), HMD (9.9 +/- 1.4%), shock accounted for 6.3 +/- 1.2%, adipose embolism and peritonitis—4.7 +/- 1.0% each, and meningoencephalitis—3.7 +/- 0.9%. Isolated cases of death occurred due to contusion of the heart, acute kidney and liver failure, suppuration of wounds, gas gangrene, thromboembolism of pulmonary arteries, air embolism, contusion of the lungs, endotoxicosis and asphyxia.

On the battlefield, death occurred in the first 10 minutes in 41.1 +/- 4.4% of cases, within 30 minutes in 69.8 +/- 4.0%, by the end of the first hour in 87.6 +/- 2.8%, within 2-3 hours in 95.3 +/- 1.7%, 4-6 hours in 99.2 +/- 0.6%,

and after 12 hours in 100% of cases. In treatment facilities, 27.8 +/- 2.5% of the wounded died during the first 24 hours following trauma, 57.6 +/- 2.7% within 5 days, and 85.8 +/- 1.8% within 14 days.

On the battlefield, within the first 10 minutes following trauma, those sustaining injuries generally died from destruction of vital organs (84.9 +/- 4.6%), during the next 3 hours—from primary blood loss (62.9 +/- 5.7%), and within 4-12 hours—basically from shock (83.3 +/- 12.1%). In hospitals, lethal outcomes started being noted within 2 hours after sustaining MET. In the first few days, victims died mainly from primary blood loss (43.0 +/- 5.2%). In second place with respect to thanatologic significance is contusion of the brain with compression and dislocation (23.7 +/- 4.5%), contusion of the heart (6.6 +/- 2.8%) and HMD (4.3 +/- 2.3%).

Predominant among causes of death 2-5 days following trauma are HMD (35.0 +/- 4.8%) and brain contusion (15.0 +/- 7%). During this time, the wounded died from pneumonia, peritonitis, festering of wounds, acute kidney failure and thromboembolism of pulmonary arteries, after 6-14 days—from pneumonia and peritonitis (30.5 +/- 4.8% and 12.6 +/- 3.6% respectively), and after 15-60 days—from pneumonia, meningoencephalitis and peritonitis. Later than 60 days following trauma, lethal outcomes ensued to equal extent (14.3 +/- 15.4% each) from festering of wounds, peritonitis, pneumonia, meningoencephalitis, sepsis and secondary blood loss. Sepsis with MET was found in 2.4% of the deceased [22]. It was most often diagnosed in suppuration of wounds of the lower extremities and soft tissues of the buttocks.

In our view, the materials generalized in this survey give an idea of the importance of research relating to morphological features of modern trauma inflicted by munitions of explosive action, the specifics of shock-wave action of new types of wounding projectiles on tissues, thanatogenesis in MET and its aftereffects, and so on. Further study of the pathogenesis and pathomorphology of various kinds of combat trauma will enable improvement of its diagnosis on stages of medical evacuation, enhancement of the quality of treatment of the wounded, and reduction of mortality.

## REFERENCES

1. Bisenkov, L.N. et al., "Contusion of the Heart in Mine-Explosion Wounds," Materials of Scientific Conference, Kabul, 1988, pp 51-53.
2. Nechayev, E.A., ed., "Vzryvnyye porazheniya" [Explosion Injuries], Tr. VMedA, St. Petersburg, 1994, Vol 236, 253 pp.
3. Velichko, M.A., Likhachev, L.V., "Specifics of Mine-Explosion Trauma From Pathological-Anatomical Data," in: "Tezisy dokladov nauchno-prakticheskoy konferentsii" [Abstracts of Scientific-Practical Conference], Moscow, Voyenizdat, 1991, pp 228-229.

4. Velichko, M.A., Chernov, E.V., "Nature of Distant Injuries in Mine-Explosion Trauma" in: "Tezisy dokladov nauchno-prakticheskoy konferentsii," Moscow, Voenizdat, 1991, pp 41-42.
5. Vyazitskiy, P.O., Komarov, V.I., Khabibi, V., "Lung Injuries With Firearm Wounds and Mine-Explosion Trauma Preceding Development of Pneumonia," VOYENNO-MEDITSINSKIY ZHURNAL, No 9, 1989, pp 19-22.
6. Vyazitskiy, P.O. et al., "Mechanisms of Development and Clinical Indications of Secondary Pneumonias in Mine-Explosion Trauma," VOYENNO-MEDITSINSKIY ZHURNAL, No 11, 1988, pp 25-28.
7. Gritsanov, A.I., "Mine-Explosion Trauma as an Acute Neurodystrophic Process. Principles of the Objective Phenomenon" in: "Tezisy dokladov nauchno-prakticheskoy konferentsii," Moscow, Voenizdat, 1991, pp 42-43.
8. Gritsanov, A.I. et al., "Kliniko-morfologicheskiye aspekty i tanatogenez minno-vzryvnoy travmy" [Clinicomorphological Aspects and Thanatogenesis of Mine-Explosion Trauma], Kabul, 1987, pp 164-165.
9. Gritsanov, A.I. et al., "Neurodystrophic Disorders in Mine-Explosion Trauma and Possibilities of Correcting Them," VOYENNO-MEDITSINSKIY ZHURNAL, No 1, 1993, pp 31-39.
10. Gritsanov, A.I. et al., "Morphofunctional Disruptions in Mine-Explosion Wounds of the Extremities and Their Significance for Surgery," VESTNIK KHIRURGI, Vol 145, No 11, 1990, pp 72-75.
11. Yeryukhin, I.A., Gumanenko, Ye.K., "Terminology and Definition of Basic Concepts in Surgery of Injuries," VESTNIK KHIRURGI, Vol 146, No 1, 1991, pp 55-59.
12. Ivashkin, V.T., "Changes of Internal Organs in the Wounded," VOYENNO-MEDITSINSKIY ZHURNAL, No 1, 1993, pp 25-29.
13. Komarov, V.I. et al., "Cherepno-mozgovaya travma v geneze mestnykh legochnykh izmeneniy u postradavshikh s minno-vzryvnymi povrezhdeniyami" [Craniocerebral Trauma in Genesis of Local Pulmonary Changes Among Victims With Mine-Explosion Injuries], Kabul, 1988, pp 245-247.
14. Kosachev, I.D. et al., "Explosion Injuries. Survey of the Literature," VOYENNO-MEDITSINSKIY ZHURNAL, No 8, 1991, pp 12-18.
15. Naser, M. et al., "Morphology of Injuries of Internal Organs in Explosive Strikes" in: "Minno-vzryvnaya travma" [Mine-Explosion Trauma], Kabul, 1987, pp 168-172.
16. Nechayev, E.A., Gritsanov, A.I., Fomin, N.F., "Controversial Issues of Terminology on the Problem of Combat Surgical Pathology," VOYENNO-MEDITSINSKIY ZHURNAL, No 11, 1993, pp 30-35.
17. Nechayev, E.A. et al., "Surgical Aspects of the Lessons of War in Afghanistan," VOYENNO-MEDITSINSKIY ZHURNAL, No 8, 1991, pp 7-12.
18. Rakhman, M. et al., "Pathomorphological Changes in Remote Segment of Extremity and Amputation Stump Following Mine-Explosion Wounds" in: "Minno-vzryvnaya travma," Kabul, 1987, pp 246-249.
19. Rogachev, M.V., Timofeyev, I.V., "Structure of Immediate Causes of Death in Explosion Trauma as a Function of Time of Onset of Lethal Outcomes" in: "Tezisy dokladov nauchno-prakticheskoy konferentsii," Moscow, Voenizdat, 1991, pp 230-231.
20. Tkachenko, S.S., "Classification of Mechanical Injuries. Results of Discussion on Classification of Injuries," ORTOPEDICHESKAYA TRAVMATOLOGIYA, No 1, 1981, pp 59-61.
21. Tkachenko, S.S., "Traumatic Infirmitiy. Results of Discussion," ORTOPEDICHESKAYA TRAVMATOLOGIYA, No 1, 1981, pp 56-59.
22. Tutokhel, A. et al., "Thanatogenesis of Deceased on Advanced Stages of Medical Evacuation Due to Wounds Complicated by Festering Infection" in: "Minno-vzryvnaya travma," Kabul, 1987, pp 253-256.
23. Fomin, N.F., "Mechanogenesis of Injuries of Organs and Tissues With Mine-Explosion Severing of Lower Extremities," VOYENNO-MEDITSINSKIY ZHURNAL, No 5, 1994, pp 12-16.
24. Fomin, N.F., Artelyev, A.A., "Pathogenetic Remarks on Substantiating Preservation Treatment of Wounds With Mine-Explosion Severing of Extremities" in: "Tezisy dokladov nauchno-prakticheskoy konferentsii," Moscow, Voenizdat, 1991, pp 86-88.
25. Fomin, N.F. et al., "Clinicomorphological Characteristics of Mine-Explosion Detachments of Lower Extremities," VOYENNO-MEDITSINSKIY ZHURNAL, No 1, 1992, pp 22-24.
26. Khabibi, V., et al., "Functional and Morphological Changes of Internal Organs in Mine-Explosion Trauma," VOYENNO-MEDITSINSKIY ZHURNAL, No 2, 1989, pp 19-21.
27. Khabibi, V., et al., "Clinicomorphological Changes of Internal Organs in Mine-Explosion Trauma," VOYENNO-MEDITSINSKIY ZHURNAL, No 1, 1988, pp 34-37.

**Study of the Effect of Exogenous Acetylcholine on the Effectiveness of Nerve-Muscle Transmission in a Fatigued Rat Diaphragm**

957A0153A Moscow BYULETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 16 Feb 94) pp 457-459

[Article by I.V. Kubasov, I.I. Krivoy, Ye.V. Lopatina, Laboratory of Nerve-Muscle Physiology, Uktomskiy Scientific Research Institute of Physiology, St. Petersburg State University; UDC 612.815]

[FBIS Abstract] Endogenous acetylcholine in the nerve-muscle synapse may not only transmit signals, it may also act as a mediator in synaptic plasticity and adaptational change. In a nerve-muscle preparation from a rat diaphragm fatigued by a single continuous stimulation, nerve tetanization leads to a significant increase in subsequent single muscle contractions. Tetanization may be due to an accumulation of endogenous acetylcholine in the muscle. This phenomenon is studied further in this paper. Fifteen minutes after acetylcholine is added to the solution there is an increase in the amplitudes of isometric contractions of fatigued muscles. The effect is not one of enhanced contraction, but rather an increase in the number of muscle fibers contracting in response to a nerve stimulus. The presence of endogenous acetylcholine in the solution triggers long-term processes involving intracellular mediators which increase the guarantee of synaptic transmission even long after acetylcholine is removed from the solution. These processes may be calcium dependent. The aftereffect of acetylcholine persisted for two hours after the acetylcholine was removed from the solution. Methods of regulating the synaptic effect of acetylcholine are discussed. Possible explanations for the aftereffect of acetylcholine are offered. The effect of other substances is contrasted with acetylcholine. Figures 2; references 9: 4 Russian, 5 Western.

**Secondary Mediators in Amiridine Modulation of Neuronal Choline Receptors in *Helix lucorum taurica Kryn***

957A0153B Moscow BYULETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 6 Apr 94) pp 470-473

[Article by Yu.V. Burov, A.S. Pivovarov, T.N. Robakidze, Laboratory of Psychoneuropharmacology, All-Russian Science Center for Safety of Biologically Active Substances, Staraya Kupavna, Moscow Oblast, Department of Higher Nervous Activity, Biology Department, Lomonosov Moscow State University; UDC 612.822.3.014.46:615.31:547.295.96.08]

[FBIS Abstract] Alzheimer's disease is characterized by a degeneration of cholinergic neurons, resulting in a persistent deficit of the cholinergic system of the brain. A new amiridine preparation developed in Russia has been highly effective in the treatment of senile dementia. It is

similar in structure to tacrin, which is used in the United States. These substances reestablish cholinergic transmission by having a modulating effect on the activity and plasticity of neuronal choline receptors, possibly due to a direct effect on the receptors and the ion channels they control. Plasticity regulators of choline receptors were recently detected among known secondary mediators, which may be involved in the regulatory effect of amiridine on neuronal choline receptors. The interaction of mediators and amiridine is studied via the volt-ampere characteristic. Two electrode recordings of membrane potential is used to study the effect of forskolin, nitroprusside Na<sup>+</sup>, calcium ionophore A23187, and EGTA on modulation of ampiridine parameters as reflected in the volt-ampere characteristic. The identified neurons PPa3 and LPa3 of *Helix lucorum taurica Kryn* are used. Forskolin and nitroprusside Na<sup>+</sup> with ampiridine weaken the ability of amiridine to increase the acetylcholine current and block the effect of ampiridine on the volt-ampere characteristic. A combination of A23187 and amiridine slightly increases the amplitude and length of the current (reduction of calcium level in cell). This may be useful because neurons of patients with Alzheimer's disease exhibit an increased calcium level. A combination of EGTA and amiridine decreases the amplitude of the current and completely reverses the effect of ampiridine, increasing intracellular calcium. Ampiridine alone can regulate the level of calcium ions in the neuron; its effect can be regulated with these secondary agents. Figures 3; table 1; references 12: 3 Russian, 9 Western.

**Effect of Immunization With Sheep Erythrocytes on Rat Behavior**

957A0153C Moscow BYULETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 6 Apr 94) pp 474-476

[Article by Yu.V. Burov, L.Ye. Davydova, T.N. Pobakidze, Laboratory of Psychoneuropharmacology, All-Russian Scientific Center for the Safety of Biologically Active Substances, Staraya Kupavna, Moscow Oblast; UDC 57.083.3:612.82]

[FBIS Abstract] It is shown that normal immune response has an effect on the physiology of rat behavior. Rat behavior is studied in an open field test and in the passive avoidance response as antibodies to a standard antigen, sheep erythrocytes, are formed. In the primary immune response, the initial period of the productive phase of antibody production, the investigatory component of rat behavior is activated (measured as the number of times the rat stood up on its hind legs in the open field test) and the passive avoidance response is reduced (movement from a light area to a dark one). Development of a secondary immune response is accompanied by a temporary increase in motor activity. Normal immune response is shown to have an effect on higher nervous activity in rats. Figures 3; references 14: 5 Russian, 9 Western.

**Effective Expression of Apolipoprotein A1 Gene Transferred into Human Cells Growing Invitro**

*957A0153D Moscow BYULLEΤEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 7 Jun 94) pp 479-482*

[Article by V.Yu. Kuryshov, N.L. Drapchinskaya, Ye.V. Tsarapkina, O.V. Savinova, Ye.V. Vorobyev, E.B. Dizhe, A.D. Denisenko, A.P. Perevozchikov, Department of Biochemistry, Scientific Research Institute of Experimental Medicine, Russian Academy of Medical Sciences, St. Petersburg; UDC 616.153.922+575.133.1+577.112.856+577.57.085.23]

[FBIS Abstract] Apolipoprotein A1 is the main protein component of high-density lipoproteins involved in cholesterol transport in human blood plasma. It is also involved in esterification of cholesterol. It has anti-atherogenic, antiviral, and antioxidant properties. It is also negatively correlated with the severe phase of inflammatory response to infection. Expression of the gene for apoA1 can be used to develop genetic treatments for a number of ailments, in particular, atherosclerosis, and possibly viral infections. Previous experiments have not evaluated the effectiveness of gene expression in cells. This paper presents information on highly effective expression of the gene for apoA1 in human cells which initially did not produce this protein. Construction of the expression vector and methods of enhancing gene expression are described. The promoter is a premature cytomegalovirus gene. Immunoenzymatic and immunohistochemical analysis revealed the protein product of expression of the transferred gene in the transformed cells. The proportion of synthesized apoA1 is 0.1-0.7% of the total protein of the transformed cells. Figures 3; references 12: 5 Russian, 7 Western.

**Study of the Specificity of Monoclonal Antibodies Obtained in Immunization of Mice With a Culture of Streptococcus Group A Treated With Pepsin**

*957A0153E Moscow BYULLEΤEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 25 Mar 94) pp 492-495*

[Article by T.A. Danilova, T.K. Asoskova, N.A. Borodiyuk, L.V. Beletskaya, V.G. Nesterenko; N.F. Gamalen Scientific Research Institute of Epidemiology and Microbiology, Russian Academy of Medical Sciences, Moscow; UDC 615.371:579.862.1].015.46.076.9]

[FBIS Abstract] When mice are immunized with a culture of streptococcus group A treated with pepsin, hybridomas are obtained which produce monoclonal antibodies with an intense reaction to antigens of streptococcus group A in immunoenzymatic analysis. All of the antibodies are class-M immunoglobulins. The reactions of the monoclonal antibodies are completely inhibited by a streptococcus group A culture treated with

pepsin. The degree of inhibition by A-polysaccharide was lower in various monoclonal antibodies. All of the monoclonal antibodies that were obtained had cross-reactions to antigens of the epithelial tissues of the thymus gland and skin of a mouse and human. The monoclonal antibodies developed here are a new group of multi-reactive antibodies that are significant, in terms of diagnosis and prognosis, in human illnesses of streptococcal etiology. Figures 2; table 1; references 12: 5 Russian, 7 Western.

**Comparison of the Effectiveness of Cutaneous and Subcutaneous Administration of Tactivin To Correct a Secondary Immunodeficient State in Young Children**

*957A0153F Moscow BYULLEΤEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 28 Feb 94) pp 496-498*

[Article by V.Ya. Arion, E.M. Bekman, N.A. Tyurin, N.A. Mazurina, A.V. Filimonova, Scientific Research Institute of Physico-Chemical Medicine, Ministry of Health, Russian Federation, Russian University of the Friendship of Nations, Moscow; UDC 616.9-001.36-022.7-053.3-085.276.4-036.8-07]

[FBIS Abstract] A noninvasive method of administering immunomodulators, in particular, tactivin, is developed. The preparation for cutaneous application is a special film containing the immunocorrector tactivin. Before use the film and underlying part of the skin is moistened with a physiological solution. The film is then applied with a leucoplast to the skin of the flexing surface of the forearm for 10-12 hours. The optimal dose of tactivin when applied in this manner is 100 µg. Comparative analysis of the use of tactivin showed that the levels of effectiveness of cutaneous and subcutaneous forms of administration were comparable in terms of immunological criteria and clinical effectiveness. Figures 2; table 1; references 13: 11 Russian, 2 Western.

**Regulation of Therapeutic and Toxic Effects of Cardiac Glycosides With Electromagnetic Radiation and Variable Magnetic and Electric Fields**

*957A0153G Moscow BYULLEΤEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY in Russian Vol 118 No 11, Nov 94 (manuscript received 28 Jan 94) pp 502-504*

[Article by A.T. Grechko, Scientific Research Division, Military Medical Academy, St. Petersburg; UDC 616-006.04-085.22:547.918]+615.847.8.09]

[FBIS Abstract] Optimization of treatment methods in oncology is a priority, as is the search for effective cytostatic agents which do not have toxic effects in therapeutic doses and which do not suppress the growth of healthy tissue. Strofantine K and digoxin, cardiac

glycosides, have been cited as substances having a cytotoxic effect. However, these substances may be accompanied by toxic effects in 7.7-60% of patients. An experiment on the hearts of standard frogs isolated in situ revealed that electromagnetic radiation and variable magnetic and electric fields had a modulating effect on the action of cardiac glycosides. Effective electromagnetic radiation parameters are determined. A direct relation was found between the modulating effect and exposure time, the strength of the electric and magnetic fields, and frequency. The data confirm an earlier discovery of stable energy and frequency windows of high biological reactivity to electric and magnetic radiation, in particular, at 2-10 Hz. The effects were manifested when both toxic and subtoxic doses of the cardiac glycosides were administered. References 11: 9 Russian, 2 Western.

#### **Effect of Synthetic Analogs of Dermorphine on Cell Division of the Epithelium of the Cornea and Tongue of White Rats**

957A0153H Moscow BYULLEHEN  
EKSPEIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 118 No 11, Nov 94 (manuscript received  
25 Jan 94) pp 508-510

[Article by M.Yu. Fleyshman, M.I. Radivoz, S.S. Timoshin, Ye.P. Yarova, S.A. Keselman, Central Scientific Research Laboratory of the Medical Institute of Khabarovsk; UDC 612.841.0143:612.6.014.43]

[FBIS Abstract] This paper analyzes the effect of synthetic analogs of dermorphine, which are predominantly agonists of  $\mu$ -opiate receptors, on cellular division processes in the epithelium of the cornea and tongue of white rats. Both analogs studied here caused depression of DNA synthesis in the epithelium of the cornea and tongue in four hours. Depression of DNA synthesis and extension of the duration of mitosis persisted for 24 hours in the tongue epithelium. In the cornea, cell division indicators normalized during this time period. It is found that  $\mu$ -agonists inhibit cell division while  $\delta$ -agonists stimulate cell division. Thus, one can achieve a broad spectrum of inhibiting effects. Figure 1; table 1; references 4 (Russian).

#### **Post-Irradiation Demyelinizing Changes in the Optic Nerve**

957A0153I Moscow BYULLEHEN  
EKSPEIMENTALNOY BIOLOGII I MEDITSINY  
in Russian Vol 118 No 11, Nov 94 (manuscript received  
28 Feb 94) pp 551-554

[Article by S.V. Loginov, Department of Histology and Embryology, Siberian State Medical University, Tomsk; UDC 616.833.115-02:615.849.1]-07]

[FBIS Abstract] Neutron and X-ray irradiation causes dose-dependent localized demyelinizing changes in the optic nerve. Radiation-induced optic nerve damage is

common when radiation therapy is used in oncology. This paper seeks to determine the role of glial and neuronal elements in demyelinizing damage to the optic nerve after exposure to ionizing radiation. Pathomorphological alterations indicating damage to components of optic nerve fibers are listed as criteria for quantitative analysis. Myelin sheaths are found to be more sensitive to radiation than axons. An important role in post-irradiation demyelination is played by the phagocytic activity of the reticular astroglia and the endocytosis of myelin by altered axons. Figures 2; table 1; references 8: 3 Russian, 5 Western.

#### **Basic Biological and Ecological Research**

957A0162A Moscow VESTNIK ROSSIYSKOY  
AKADEMII NAUK in Russian Vol 64 No 9, Sep 94  
(signed to press 25 Aug 94) pp 797-803

[Article by V. Ye. Sokolov, academician-secretary of the RAS Department of General Biology, director of the RAS Institute of Evolutionary Morphology and Ecology of Animals imeni A.N. Severtsov, under the rubric "Organization of Research"; first paragraph is VESTNIK ROSSIYSKOY AKADEMII NAUK introduction]

[FBIS Translated Text] In late January 1994, there was a discussion in the RAS [Russian Academy of Sciences] Presidium of the activities of the Department of General Biology. Basic research carried out at institutes in this department are directed primarily toward judicious use of biological resources, since the condition of the biosphere and progressive development of civilization depend to an enormous extent on preservation of the bioresource potential of the planet. The editorial board is publishing the report of the academician-secretary of the Department of General Biology and discussion of this report.

The Department of General Biology was formed as an independent structure of the Academy of Sciences in April 1963. At present it comprises 12 institutes and provides scientific and methodological leadership for 29 research institutions at regional departments and research centers of RAS. The following are contained within its system: 12 functional scientific boards, 2 commissions, the National Committee of Russian Biologists, 12 scientific societies and 17 scientific periodicals. Thus, the Department is a complex, multilevel system.

Many prominent biologists have worked in our institutes: V.N. Sukachev, M.S. Gilyarov, Ye.M. Lavrenko, Yu.A. Orlov, Ye.N. Pavlovskiy, and S.S. Shvarts. At present, it is manned by 15 academicians and 31 corresponding members of the Academy. The Department's central institutes are staffed by about 5000 people, including 329 doctors of sciences and 1061 candidates. Thus far, there has been little "drain" of specialists, even though there are difficulties with funds, as well as materials and publications.

Basic research carried out at department institutes is integrated in the program "Problems of general biology and ecology; judicious use of biological resources." The concept of biological resources includes not only economically significant forms, but also the entire natural diversity of the plant and animal kingdom. Biological systems maintain the circulation of matter in nature, restore soil fertility, and regulate gas composition of the atmosphere; in other words, they provide for the existence of life on earth. It is not surprising that preservation of biological diversity has become an extremely important task in our times. The Convention for biodiversity, which was also endorsed by our country but not yet ratified, was approved at an international UN conference on environmental protection, which convened in Rio de Janeiro (1992).

Unlike other forms of natural resources, biological ones have the unique capacity of self-restoration. Their use must be judicious and conservative; one can use exactly as much as is restored. Unfortunately, this principle is often not followed, and this leads to decline of the bioresource potential, loss of biodiversity. The policy of setting prices for biological resources and, incidentally, the existing system of fines for breaking rules for use of natural resources, is still extremely unsatisfactory.

The Department of General Biology considers its task to be performance of basic research directed toward creating a national informative database on the condition of biological resources, development of standards for their use and expansion of the bioresource base.

Of course, within the limits of a report I cannot discuss the entire diversity of scientific directions on which our institute is working. I shall start with **developmental biology**, which is a multidisciplinary complex science that studies the mechanisms of animal and plant development at all stage of the life cycle, from fertilization to aging and death.

Diverse studies of individual life of multicellular organisms (their ontogenesis) have in common two key problems of biological development. The first pertains to mechanisms of cell differentiation, i.e., appearance in the course of development of a diversity of sex and specialized somatic cells; the second, to mechanisms of interaction of these cells. The problem of intercellular interactions in the broad sense includes contact interactions, as well as remote (by means of humoral substances), spatial, positional, and form-producing processes.

In recent years, the advances in molecular biology and genetics, first of all in the area of transgenesis—transfer, introduction of foreign genes, synthetic genetic structures, fragments, DNA sequences in embryonic cells (fertilized ovicells—zygotes), have been used with very much success in developmental biology. In this case, it is possible to obtain a transgenic animal, in which all cells including reproductive ones contain the inserted gene. By means of hybridization and breeding, this specimen

could produce a transgenic line of animals with a unique genotype. If a gene (DNA structure) is inserted in the stem cells of some tissue, for example, hemopoietic, it is not inherited.

Studies that make use of transgenesis methods may pursue the most varied purposes. For example, a gene under study could be added in order to alter or correct cell functions. This is being done with the genes of growth factors, enzymes, cellular receptor proteins, resistance (insusceptibility) to pharmacological agents or antibiotics, etc. In addition to solving basic problems, such studies are called upon to offer experimental and theoretical validation of possible procedures in gene therapy, treatment of inherited pathology, as well as basically new procedures for increasing bioproductivity.

The gene under study can be inactivated. Very recently, procedures designated as targeted mutagenesis began to be used. They can be used to assess the role of virtually any gene (fragment, DNA sequence) in development of an organism.

The advances in developmental biology (and to an equal extent in general biology, and genetics) include many years of study of sex regulation and parthenogenesis in animals. They serve as the basis for fruitful theoretical conceptions on the mechanisms of variability of organisms, mechanisms of heterosis, which is still a mysterious phenomenon involved in increasing productivity of hybrids, as compared to parent breeds or varieties. The high efficacy of this method has been confirmed, first of all, on the Chinese silkworm, as well as drosophila, peas and barley. Heterosis permits increasing the productivity of farm crops by 15-20 percent in a single generation. Hybrids of two farm crops obtained by this method have already been zoned [for growing] and yield a large economic effect.

Basic research in **general genetics** is being pursued in four main directions: genetics and evolution of populations as related to protection of the biosphere and judicious use of biological resources; human genetics; structural and functional organization of the genome; genetic principles for breeding plants, animals and microorganisms.

Geneticists have developed an effective method for breeding and seed growing, which permits not only improvement of productive qualities of a breed or variety, but also to preserve their genetic diversity. The method consists essentially of combining moderate discriminating selection according to productivity characters with concurrent stabilizing selection for traits that have adaptive significance. A variety of tomatoes developed by this method is notable for very early ripening, high productivity, uniformity (simultaneous ripening) and good flavor. A new variety of sunflowers obtained by the same method is genetically uniform, matures early, is resistant to diseases, and its seeds have a high oil content.

In the last 3 years, four agricultural crops have been developed in Siberia and zoned: winter tetraploid rye, barley, corn, beans; two triticale varieties (wheat-rye hybrid); Snegirevskiy grain fodder variety which produces a large grain and green mass harvest, and Snegirevskiy-699, which is resistant to lodging, with a potential productivity of 100 quintal/ha fodder grain (zoned in Moscow Oblast in 1992). Three varieties of winter wheat have been deemed promising, and they are successfully undergoing State and industrial testing.

The population genetics approach was fruitful in the study of man. Data have been gathered on the genetic distinctions of the populations of Russia and adjacent countries, including information about many polymorphous genes for more than 2000 populations. This unique material, which is stored in a computer bank, made it possible to reveal the specifics of genetic processes over an enormous territory of Eurasia, and to demonstrate spatial inheritance of heterogeneity of the populations studied. An integral map of the gene pool, as well as an electronic gene-geographic atlas of ethnic peoples of Russia and adjacent states were charted using computerized cartography. Work has begun on a unique five-volume series dealing with human gene geography.

On the example of studying genetic processes in large cities, in particular Moscow, it was established that social environmental factors play a leading role in genetic dynamics of human populations. Previously obtained data on the adaptive structure and optimum levels of gene diversity of population gene pools permitted validation of the concept of ecological-genetic monitoring of man, animals and plants. On its basis, one can assess deviations in regional gene pools from the historically developed species-specific optimum, as well as forecast and prevent the adverse consequences of such deviations.

In the area of molecular genetics, the department's institutes devote attention mainly to structural and functional organization of the genome. In particular, the genomes of some mammalian species have been mapped. Studies are in progress of the structure of genes that are of adaptive or economic importance. For example, the structure of hordeins, which are spare proteins of barley seeds responsible for brewing qualities, has been identified. Molecular genetic mapping of hordein genes made it possible to establish that they are linked with other genes responsible for plant resistance to disease. Analogous work is being done with bacteria.

In the area of paleobiology and evolution, in addition to the study of different groups of organisms as related to the history of earth's biosphere, studies of ecosystems are in progress, in particular, of the plant and animal world of lakes of the geological past.

A new conception has been developed on phylogenesis of the avian class. It is assumed that the archaeopteryx is not the ancestor of contemporary birds. Perhaps the

latter originated from the North American Jurasic protornis. Adaptation to flight apparently developed independently in the archaeopteryx and ancestors of contemporary birds.

The enormous role of the bacterial factor in evolution of the biosphere has been proven. This is particularly well demonstrable on the example of phosphorite formation. The organic kingdom of the Vendian period (680-570 million years ago) has been described. At that time, communities of multicellular marine animals were added to the previously prevailing archaic biocenoses consisting mainly of bacteria and blue-green algae.

Glancing at the history of development of life on our planet, we can conclude that this process in general is directed from the simple to the complex, from the single to the multiple, from uniformity to diversity. As a rule, when examining the process of evolution of life on earth, attention is given mainly to productivity, to biomass. Yet the evolutionary process is not directed toward increasing productivity, rather toward increasing relative stability, which is possible only if there is perfect regulation. The latter occurs only through diversity. Competition, the most important moving force in evolution, leads to increase in diversity, since it results in separation of ecological niches.

Biological diversity can be considered on different levels, from the molecular and gene levels, to populations, species, communities and ecosystems. Here are some examples of studies being conducted at institutes of the Department of General Biology on the gene, population and species levels.

It was established that the gene pools differ in many of the spawning Siberian salmon populations. This difference can be expressed graphically, and then each population will have its own genetic "profile." This is a good indicator of interpopulation differences. But there is also intrapopulation diversity.

Within a single population of Far East *Oncorhynchus nerka* salmon there are at least two forms. One is characterized by large males that swim from the sea to rivers to spawn earlier than the small males of the other form. As a rule, when forming spawning pairs, the females prefer large males that reach sexual maturity late (at 5-7 years), but in years when there is little water and in shallow spawning places which large males cannot reach, reproductive success is inherent in the small males which mature earlier (3 years).

It was found that these forms differ from one another genetically, in protein loci. The large males have a minimal level of heterozygosity (gene diversity) and the small ones, a maximal one. In normal schools of red salmon that have not been the target of commercial fishing, there are many large males and few small ones. Until recently, however, both sea and river (particularly in the spawning period) commercial fishing was aimed at larger males that spawn earlier. Fishing was done mainly

at the start of the spawning swim. Thus, small forms of red salmon males had an advantage in reproducing and transmitted their genes to an ever increasing extent to the next generations. This had the effect of worsening the commercial quality of red salmon populations. Fish began to reach sexual maturity earlier, after which they stopped growing (at a small size), their mean life span diminished and generations succeeded one another at a faster rate. Concurrently, there was a decline in population size, since small females have lower fertility. Fishing disrupted the mechanism formed through evolution of maintaining intrapopulation genetic diversity. To remedy the situation, it is necessary to catch red salmon uniformly and proportionately throughout the period of its spawning run from sea to rivers.

The study of biological diversity on the level of species has a long history, and has become traditional in institutes of the Department of General Biology. The estimated number of species inhabiting earth is 5-30 million, but much fewer have been studied (Table 1). A considerable number of species is described each year, particularly when a new method appears or new habitats are discovered, for example, tree crowns in tropical forests. A year and a half or two ago, our zoologists described a new type of animals, similar to worms. They are the so-called Cephalorhyncha, small, up to a few centimeters long, essentially marine benthonic animals with a movable proboscis on the head. In 1992, a new species and genus of Pseudooryx antelopes was described in Vietnam.

**Table 1. Number of Known Species of Current Living Organisms (Wilson, 1988)**

Organism	Number of Species
Viruses	1,000
Bacteria, mycoplasma, cyanobacteria	4,760
Fungi	46,983
Algae	26,900
Plants	248,428
—dicotyledons	170,000
—monocotyledons	50,000
Protozoa	30,800
Invertebrates	989,761
Chordates	43,853
—teleosts	18,150
—amphibians	4,184
—reptiles	6,300
—birds	9,040
—mammals	4,000
Total	1,392,485

It must be said that there had been constant extinction of some species and appearance of others in the many-million-year history of the animal and plant kingdoms on earth. We all know about the mass death of dinosaurs, and intensive extinction of mammals in the relatively recent past. Whether this process is normal or related to some external events, perhaps disastrous ones, is still not clear. Species formation continues in our times also. For example, new species of sheep are appearing at different points of the globe. Even now, groups of sheep that live in isolation in Tien-Shan, Altay and Karakumy differ from one another in their gene system, although by their appearance (size, structure of horns) they could be connected in a virtually unbroken group to group chain. But

if they continue to be isolated for a thousand years, there will be inevitable inherited changes as a result of mutations, and these groups will develop into separate, and quite distinct species.

Some excellent work on describing the diversity of species in our country has been done by botanists and zoologists of the Department (Table 2). Their data have been published in multivolume editions of "Flora" and "Fauna." Abundant zoological, paleontological and botanical collections have been gathered in our museums and botanical gardens. They are also working on acclimatization and introduction of plants. Zoological and botanical collections are just as precious as collections of works of art or unique scientific installations. And we must do all we can to preserve them.

**Table 2. Number of Known Organism Species on the Territory of Russia and Former USSR**

Organism	Number of species	
	Former USSR	Russia
Mammals	275-400	
Birds	816	729
Reptiles	175	72
Amphibians	37	29
Fish	1000	
Insects	120,000	80,000
Other invertebrates	45,000	40,000
Higher plants	20,000	10,000
Fungi	25,000	
Mosses (bryophytes)	1,700	1,500
Algae		16,000

Note: This table was prepared from the data of the RAS Zoological Institute, Ecological Museum of Moscow State University, RAS Botanical Institute imeni V.D. Komarov, RAS Main Botanical Garden imeni N.V. Tsitsin.

It is well known that it is impossible to save a species from extinction without preserving its habitat. Virtually all of the institutes of the Department of General Biology are working on environmental protection: problems of protected territories (preserves and biospheric preserves), identification of rare species at risk of disappearing, and elaboration of recommendations to preserve them. Loss of biodiversity is increasing annually (Table 3). The general situation in the matter of preserving rare species in Russia, such as the tiger, saiga,

and kabarga [musk deer] has reached critical proportions. One of the directions of our work is to compile "Red books." Ten years ago the "Red Book of the USSR" was published, and at present the "Red Book of Russia" is being prepared jointly by the Academy of Sciences and Ministry of Environmental Protection. Let me note that, in recent year, the ethical aspect of environment protective work is gaining increasing importance: every living thing has the right to life, and man is responsible for respecting this right.

**Table 3. Loss of Biodiversity in Europe**

Organisms	Disappeared or endangered		Disappeared in Europe
	Europe	whole world	
Fungi	30-55	5	10-15
Lichens	20-25	5	1-5
Algae	10-90	5	1-10
Mosses	40-60	1	3-20
Vascular plants	22	4	5-15
Invertebrates	30-60	10	5-20
Fresh water fish	53	4	2-4
Amphibians	23	3	1-3
Reptiles	45	2	1-2
Birds	25	11	2-15
Mammals	47	8	10-20

A dangerous trend toward commercialization of management of preserves in Russia has emerged in recent times. There are plans to make preserves self-supporting, and they are confronted with the task of earning money, as is done by the national parks in Africa. But it is one thing to have a national park with beautifully developed infrastructure, where people relax in touch with nature, and another thing to have preserve-occupied territories.

A system of biospheric preserves is being developed all over the world. There is mandatory designation of undeveloped land for them, and people are not allowed access to it. It exists solely to protect the environment. Commercialization of Russian preserves carries the threat of a complete disaster, and the Academy of Sciences must avert this threat. All institutes of the Department of General Biology are involved to some extent in other

with problems of ecology. The topics are quite diverse, and for this reason I shall discuss only a few of them.

In recent years, we are learning about the increasing importance of soil as a habitat, the influence of soil processes on gas composition and dynamics of the atmosphere, chemical composition of the hydrosphere, and first of all of inland waters. Studies in this direction help predict evolution of soil under the effect of global changes in climate and anthropogenic factors. The teaching on diversity of structures of the soil cover is being used more and more extensively for practical purposes by agricultural specialists and ecologists. On its basis, soil-protective, and adaptive-landform systems of agriculture are being developed.

Publication in 1990 of the 16-plate Soil Map of the Russian Federation to a scale of 1:2,500,000 was an important result of the many years of studies of soil scientists. This fundamental work on soil mapping reflects the present level of knowledge about the diversity of Russian soils, structure of its soil cover and possibilities for using soil resources.

Systematic soil-mapping studies and observations in different natural zones of evolution of soils revealed that the rate of their destruction and degradation under the influence of erosion and anthropogenic pollution is growing catastrophically. In the history of civilization, mankind has already lost about 2 billion ha of biologically productive soil, converted into deserts and sterile land. This is more than the area of land farmed today all over the world. In the last 50 years, the rate of degradation has increased by 30 times, as compared to the historic mean. The world loses 7-8 million ha of fertile soil each year.

In Russia, two-thirds of farm land and half the pasture land are subject to processes of erosion and anthropogenic degradation. In urban and industrial regions, the soil is contaminated with heavy metals and petroleum products (about 10 million ha), and radionuclides (about 5.5 million ha); an intensive process of depletion of the land is occurring in the Caspian region. Each year, 1.5 million ha of biologically productive soil (including 0.5 million ha of farmed land) is lost in the Russian Federation. Urgent steps are needed to protect it.

Forests, like the oceans, are the main oxygen producers on earth. They play an extremely big part in accumulation of carbon, production of biomass, and effect on climate. They have water-conserving, soil-protecting, sanitary-hygienic and recreational functions. Their economic value is not limited to the fact that they provide wood used by man. Forests are the habitat for many animals, birds and insects important to man. Production of organisms that inhabit forests is sometimes more valuable than wood pulp.

Russian forest science is characterized by a biogeocenotic approach, which makes it possible to provide a comprehensive assessment of resources and ecological

functions of forests, including their relation to global changes in the environment and climate. At institutes of the Department of General Biology studies are in progress of the structure and productivity of boreal forests under different climate conditions, as well as modeling and forecasting the dynamics of forest resources under the influence of global changes, forest monitoring, and they are also developing geodata systems for forest resources.

At the present time, it is boreal, rather than tropical forests that are considered to be the active consumers of carbon from the atmosphere. A considerable part of such forests is in Russia. In general, the forests of Russia constitute 23 percent of the world forest resources and 40 percent of the stock of the most valuable conifers. Their living phytomass accumulates 41.2 Gtons of carbon. One-third of the earth's swamps are in Russia. There an even greater amount of carbon (115-160 Gton) is concentrated, while annual binding of atmospheric carbon dioxide by swamps compensates for 10-12 percent of its emission from burning fuel. When there is release of carbon contained in forests and peat bogs (for example, with combustion), there is dramatic increase in probability of the so-called greenhouse effect, which would lead to substantial change in the image of our planet.

There have been great advances in reclamation of plants in treeless territories, in particular, saline semiarid land. True, a considerable part of the territory where these studies were conducted (Dzhanybek base) is now in another state, Kazakhstan, and for this reason the future of both the forest belts and our studies there is not clear. Forests sustain enormous losses in fires. Methods of controlling them are being developed, and a map has been charted of potential forest fires. An alarming situation is developing in our country in the matter of forest use, since forests are being handed over to the jurisdiction of local authorities.

There is another direction of ecological studies in the Department: hydrobiology and ichthyology. Theory of water ecosystem function has been elaborated, diagrams have been plotted of the balance of matter and energy for a number of fresh water reservoirs and seas of Russia. Studies have been made of the structure and dynamics of fresh and salt water ecosystems; correlations have been found between trophic levels, in particular, between primary producers and consumers, and studies have also been made of the flow of matter and energy in ecosystems.

Assessment of supply and development of catch norms are important to judicious use of marine biological resources. For this purpose, studies have been made of the dynamics in quantity, distribution and migration of objects targeted by the fishing industry, the supply thereof and condition of gene pool. On the basis of vast factual material, several mechanisms have been found for regulating the number of hydrobionts, mathematical

models of populations thereof have been proposed, and recommendations were offered for judicious fishing.

Progress in the study of mechanisms of the bioproduction process made it possible to turn to control of populations of marine organisms with use of aquaculture. The biotechnology for raising mussels, herring, oysters and other commercial objects has been developed and introduced. There has been assessment of the impact of intensive mariculture of mollusks and fish on biocenoses of coastal waters, and a method has been developed to estimate the ecological capacity of areas of water as related to anthropogenic eutrophication.

Nowadays, when severe anthropogenic water pollution is occurring, studies of marine toxicology have become particularly important. Russian specialists have elaborated the methodological basis for setting ecological standards for toxic pollution of water, as well as methods and guidelines for biotesting, assessment of ecological (including long-term) consequences of biota exposure to pollutants. The biota of many bodies of water in Russia, including different seas and large lakes, has undergone degradation under the impact of diverse anthropogenic pollutants. Thus, as a result of pollution and overfishing, there has been destabilization of the ecosystem of the Barents Sea. In the last 10 years, there has been a 3-5-fold reduction in number of commercial fish there. Trophic relations in the sea have been disrupted, overfishing for capelin led to dramatic reduction in number of its consumer, the cod, as well as in number of birds and seals.

The state of sturgeon resources is causing great alarm. In the past, their catch constituted 25,000-30,000 tons per year, which corresponded to 98 percent of the world catch. At that time, at the recommendation of scientists, diverse measures were implemented for protection and reproduction of these fish, and sea fishing was banned. The Caspian Sea was transformed into a unique "sturgeon sea." At present, its waters are divided among several states. Predatory sea fishing for sturgeons has begun, and there has been a dramatic increase in number caught by poachers. As a result of this, as well as continued pollution of the Volga River, the annual catch began to decline. Less than 10,000 tons were caught in 1992, while in 1993 the catch in Russia was only 4200 tons. Speedy conclusion of an international agreement is needed concerning reproduction, conservation and use of sturgeon resources of the Caspian basin, with provisions for a total ban of fishing for them in the sea, and effective monitoring of adherence to this ban.

Scientists in the Department of General Biology are carrying out studies on ecological problems of the Arctic and sub-Arctic regions. They are studying populations of plants and animals, their adaptation to extreme conditions, communities and ecosystems of the North. With the current intensive development of northern territories there is a real threat of impairing the environment in this vast region.

At virtually every institute of the Department the share of ecological studies is increasing. Studies are in progress of the effects of new abiotic factors of anthropogenic origin, first of all radionuclides and dioxin, on organisms, populations, communities and ecosystems. Genetic and radioecological studies were carried out in the regions of the Chernobyl Nuclear Power Plant and accident in Kyshtym, in the Southern Urals. Animal reactions to the "closed nature" of the territory are interesting; thousands of ducks, geese, and many deer live there. It has been shown in rodents that some organisms are not adapted to increased radioactivity, but within a species there is selection of radioresistant specimens, so that the population survives.

Many of the scientists' recommendations have found practical applications; in particular, steps are being taken to reduce toxic industrial emissions into the atmosphere and water. But this obviously not enough to protect the environment. Unfortunately, the suggestions of scientists concerning protection of forests, soil, animal and plant kingdoms have not yet received support on a government level.

Rossiyskaya akademiya nauk. Prezidium RAN, 1994

#### Biodiversity—Key Problem of Biology. Discussion in RAS Presidium

957A0162B Moscow VESTNIK ROSSIYSKOY AKADEMII NAUK in Russian Vol 64 No 9, Sep 94  
(signed to press 25 Aug 94) pp 803-807

[Article under the rubric "Organization of Research"; first paragraph is VESTNIK ROSSIYSKOY AKADEMII NAUK introduction]

[FBIS Translated Text] The report of Academician V.Ye. Sokolov was followed by discussion of the main points it raised. The content of the discussion is published below.

#### Academician V.N. BOLSHAKOV:

I think that in discussing the work of the Department of General Biology one should pay special attention to expert ecological opinions and ecological forecasting. Very often many institutes that have a relationship to ecology have to deal with such things, for example, the institutes of the Ural Department that I am representing here. It is quite obvious that it is impossible to make such a forecast without fundamental development of ecological directions, particularly since the main method of ecological expertise is still the method of expert evaluations, rather than the method of analogy or mathematical modeling.

The Department of General Biology and institutes under its supervision have found their place in ecology. They are working on the study of structure, function, resistance and productivity of natural systems. Without such studies no ecological forecasting or expert opinion would be possible. This is what I wanted to note first of all.

The second problem, which is of particular interest to me, is establishment of national research centers dealing with biological topics. It is stated in an ukase of the Russian President that such centers must have unique equipment. Institutes dealing with biology have the only collections, herbariums, etc., of their kind. For example, the herbarium of the Ural Society of Nature Lovers, which is more than 200 years old, is at the Institute of Plant and Animal Ecology in Yekaterinburg. Problems of preserving it are probably just the same as for the collections in the Botanical Institute in St. Petersburg. Moreover, we know of absolutely unique bases and biological stations, for example the biophysical center at the Beloyarsk nuclear power plant. One could probably establish government biological research centers on the basis of such institutions.

I believe it is necessary to mention the problems of the journal EKOLOGIYA, of which I was recently reappointed editor-in-chief. It holds a record among biological journals in number of subscribers. Unfortunately, issues are published with great delay: in January 1994, subscribers had not received the fourth, fifth and sixth issues (it is published bimonthly) for 1993. EKOLOGIYA is a journal of the Department of General Biology, but since it is printed in Yekaterinburg, it is considered a regional journal. However, the editorial board considers it a journal of the Russian Academy, and for this reason it cannot be regional. The journal is translated in the United States, and its authors and editorial board are well known. I wish to take this opportunity to ask R. V. Petrov, RAS [Russian Academy of Sciences] vice-president, and Academician V. Ye. Sokolov to do all they can so that Academy journals would find their way to readers.

In conclusion, a few words about the relationships between specialized departments, in particular, between the Department of General Biology and regional ones. V. Ye. Sokolov said that the Department of General Biology directly supervises 12 institutes and implements scientific-methodological supervision for 29 institutes situated in different regions. As we see, scientific and methodological supervision constitutes a rather substantial share of the Department's work. I imagine that the Department has found optimum forms of relations with regional departments, including the one in the Urals.

#### A.V. YABLOKOV, corresponding member of RAS:

For the last few years I have been looking at a distance at the activities of the Department of General Biology where I had worked my whole life, and this position allows me to make two remarks.

Last year, the "Biological diversity" program was approved thanks to the titanic efforts of the Bureau of Departments and V. Ye. Sokolov. This is a positive event in the Department's work against a background of a cut-down in all research programs. Thus, the program was approved but, as before, sturgeon and tigers are

being destroyed. Of course, the Academy of Sciences cannot stop this mass destruction, but it could have made things easier, it could have created genetic banks so that species would not disappear forever. Yet banks such as this that exist in our country are in a sorry state. If we do not remedy the situation in the next five years, we will indeed lose many species. They can be preserved in a genetic bank in the form of seeds, embryos and DNA, and then there would be at least a theoretical possibility of restoration. Large sums of money are not needed to develop genetic banks, and the Academy must devote attention to them. This is my first remark.

In maintaining that ecology is a biological science, the Department claims the role of theoretician in this science. But then, why is not the concept of ecological risk being developed in the Department? V.N. Bolshakov has already stated that expertise is carried out mainly in the form of expert evaluations. And this will continue until we elaborate a modern scientific concept of ecological risk. Of course, in addition to the Department of General Biology the entire Academy should participate in this. The concept of ecological risk is the scientific basis for determining what can and what cannot be done to develop the national economy.

I shall now turn from critical remarks to positive experience. I wish to show how Russian science can survive on the example of the Department of General Biology.

The work done by the Department is important to the entire world community. I am confident that one can find a partner in the United States, Great Britain, France, etc., for each major project of its institutes. We shall be able to save them if we find a partner for each in North America or Canada. Our government cannot at the present time provide for the operation of preserves, while the private funds allocated to them constitute 18 million dollars according to the latest McArthur program.

As for the "Biological diversity" program, we have a unique opportunity to obtain foreign aid to implement it. The world realizes that Siberian forests consume more carbon dioxide than the Amazon. It would benefit the world to preserve expressly Siberian forests in order to stabilize climate. We have estimated that while the industry of Germany must reduce emission of carbon dioxide and spent 500 billion marks to do this, we could plant forests that would consume the amount of carbon dioxide emitted by the entire German industry for one-tenth this amount, 50 billion marks. It is more effective for Germany to invest in forestation in Russia than in its own industry. At present, work in this direction is being done on an international level. Russia has the largest territory in the world, and we should make use of this advantage.

#### Academician G.V. DOBROVOLSKIY:

Academician V. Ye. Sokolov very properly devoted considerable attention to the problem of preserving biological diversity. At the present time the entire scientific (and not only scientific) world is interested in this.

Overcoming the negative process of reduction in biological diversity, reduction in species representing all the wealth of the animal and plant kingdom on earth, is also related to preservation of the habitat of these organisms. I wish to stress that soil, the top soil, is one of the main habitats of living organisms. Indeed, about 50 percent of all animal species in terrestrial ecosystems are concentrated in soil, and this corresponds in weight to 90-95 percent of the biomass of terrestrial animals. The entire diverse kingdom of terrestrial plants and microorganisms is also related to soil. One must have an absolutely clear idea that without preservation of soil and all its diversity it is impossible to preserve the diversity of the biological kingdom.

Erosion is the chief enemy of top soil. A special study was made of the correlations between erosion rates at different periods of the Holocene epoch, including the last 300 and 50 years. It was found that in the second half of our century the rate of erosion processes was 30 times faster than the mean historic rate. Professor L. Brown, head of the Washington Institute of Global Studies believes that one should view the process of destruction of top soil, which is the main habitat of living terrestrial organisms, as the "quiet crisis" of our planet.

I believe that the initiative of A.V. Yablokov, corresponding member of RAS, should be approved with regard to raising for discussion the question of destruction of Russia's top soil as a national threat. Indeed, the quality of top soil is important not only to preservation of biological diversity, but also to your existence and mine, since soil is the main source of foodstuffs.

Can one prevent erosion processes? The experience of many research institutions and farms proves that this is possible. Recently, I visited the farm of the well-known agronomist-ecologist, A.P. Aydak, in North Chuvashia. In that region there are strongly developed erosion processes, but they have been totally arrested at farms. A.P. Aydak, as a competent boss, made good use of the recommendations of science and practical knowhow. He has all of the land covered with vegetation, which prevents the formation of ravines and processes of planar erosion. Unfortunately, this knowhow is not utilized broadly enough.

#### Academician A.S. ISAYEV:

Problems related to forests have been studied in the Department of General Biology for a long time. Russian forest science has always held leading positions in the world. It was based on the biogeocenotic approach, contained in the general ideological concepts of the biosphere developed by Academician V.I. Vernadskiy. But things developed historically in such a way that there was little demand for the enormous scientific potential created in Russia, not only at the Academy of Sciences, but also in other institutes concerned with forests. In recent times, thanks to development of international exchange and intensification of our ties with foreign

colleagues, there has been unusual increase in interest in Russian forest science. It did not increase because Russia is a forest state. At present, extremely great attention is being displayed in forests as a component of the biosphere, particularly if we consider global changes in climate that are predicted for the start of the next century.

At the conference in Rio de Janeiro, where I had to work as an expert in the Soviet delegation, the forest question was dominant. All political leaders, beginning with Bush and Kohl and ending with the leaders of African and South American countries discussed forests in their speeches. It is not surprising that programs related to forest problems are among the priority problems of the world.

What is happening with Russian forests? As a man who has been working in this field all my life, as the former chairman of the State Forest Committee, I can say that today the forest situation in Russia is somewhat stabilized, mainly because of the decline in industry: there has been a 50 percent decrease in cutting. As for the forest utilization system, it remains at its former low level. Moreover, the Law "Fundamentals of Forest-Related Legislation," which was approved in 1993 by the RF Supreme Soviet, turned out in essence to be inoperative, since it does not stipulate the main point: the question of ownership of the forests. All levels of local authorities consider themselves to be the owners, and each issues its own legally binding documents. This leads to decentralization of forest management, disruption of standards for forest utilization and degradation of the forest stands, the ecological frame on which all environment-protective measures are based.

In the Academy, forest science is represented by several regional institutions, which continue to operate under extremely difficult conditions. Perhaps the worst thing for us is the lack of funds for field studies. Forest specialists cannot work solely indoors, they must go on expeditions. Our precious heritage, field bases, which were established for many years, must be preserved and multiplied. A forest is not like corn, it grows for hundreds of years, rather than one. We are losing many bases that are being destroyed, and the objects of the studies are being cut down.

In view of the enormous interest in forests on the part of foreign scientists and politicians, there is a demand for knowledge abroad. At one time, the State Forest Committee concluded contracts with the United States, Canada, France, Italy, China, and Scandinavian countries. At the present time, various international foundations that allocate funds expressly for forest programs, are operating effectively. Bush, for example, allocated 100 million dollars after Rio de Janeiro for the "Forests of the Future" program. These millions were spread all over the world and settled in foreign foundations. As a result, the money earmarked for the study of Russian forests as a unique object is being used for other purposes.

The opinion prevails abroad that foreign specialists can study Russian forests better. One of the largest international forest projects is funded through the International Institute or Applied Systems Analysis. There, an international team of scientists is at work, but most of the work is planned in Russia. An agreement has been concluded between this institute and the Russian Academy of Sciences for a large-scale project on "Forest resources of Siberia, environmental protection, problems of socioeconomic development." It is funded in part by the United States. True, thus far only 700,000 out of the millions of dollars allocated by Americans reached the International Institute of Applied Systems Analysis. Other investments in this project are expected.

Unfortunately, we see a trend toward using Russian specialists mainly to gather data on Siberian forests, that is to say that we have been cast in the role of self-styled suppliers of "intellectual raw material" for foreign analysts. We believe such an attitude to be utterly unacceptable.

Our rigid and unbending stand in this project is to work as equals. Since the project involves Siberian forests, Russian specialists must participate in implementing it on the analytical level. Particularly since the information about Russian forests that we have is unique. No other country in the world has such extensive information about the composition, structure of forests, their ecological functions, and forest utilization systems. We are ready to share this information with the world community, but to share in the interests of solving common problems. Information about Siberian forests should help gain better understanding of their role in global climate changes and carbon content on our planet.

#### **Yu.P. ALTUKHOV, corresponding member of RAS:**

The problem of biological diversity is classified in the United States among global ones, such as preservation of the ozone layer, prevention of the possible intensification of the greenhouse effect, etc. The fact of the matter is that, according to estimates of well-known American ecologists, there is disappearance from the face of the earth of one biological species per hour. This means that by 2010-2015, the earth could lose up to 15-20 percent of its species. It is not difficult to imagine what would happen after this.

There can be different attitudes toward the problem of biological diversity, but it is quite obvious that one cannot have the attitude that prevails at present in our country toward it, as well as to basic science. V. Ye. Sokolov mentioned the work being done at the Institute of Genetics. Much of it is on a par with what has been accomplished abroad, but at this time it seems that no one needs it.

At one time, we were able to convince the Ministry of the Fish Industry to manage salmon fishing correctly. It believed us only after it was evident that our developments are recognized in Canada. At present, however, under the banner of private ownership, plundering of

salmon schools has begun. We do not comprehend just who could need our recommendations, which are aimed at preservation and reasonable utilization of fish resources.

I believe that one should abandon the illusion of mass assistance of the West. Science is international, and scientists should work together, but one can interact with our foreign colleagues only as equals. It is virtually impossible to do this at present, since the funding of our institutions and western ones is not comparable. Our western colleagues want to participate in joint expeditions, and we are not in a position to organize our own.

In conclusion, I wish to stress that it is very important that different directions are represented in the Department of General Biology—botany, zoology, and genetics. Interaction of specialists in different directions makes it possible to obtain a new quality in the research process. It is only a question of whether the historically established Russian scientific schools will be preserved, whether they will be supported by the government.

#### **V.N. TIKHOMIROV, corresponding member of RAS:**

We often pronounce the words, "biological diversity," but by far not all of us know what it is. I maintain with full responsibility that there is not a single specialist who would furnish a complete answer to the question: How many plant species, insect species, and vertebrate species inhabit the territory of our country? In other words, biological science has not yet completed (and will never complete) an inventory of everything we have.

Let me cite an example with flowering plants. Each year, several thousand new species of flowering plants are described in the world, which had been unknown, and, consequently, had not been part of the economic turnover. Of course, most of them are encountered in inaccessible regions. But believe me, I myself have described several species from Moscow and Vladimir oblasts, and from Mordovia.

At present, there is an agreement with our American colleagues about a basically new international project, the multivolume "Flora of North-East Eurasia." It was important for the American side for the project to be approved by the Russian Academy of Sciences. We are not asking for funding and, I believe, it is unlikely that we will, but a decision by the RAS Presidium concerning this project is extremely desirable. If the project is carried out, the flora of North America, China, Mongolia, Europe and all of our Eurasian territory will be covered by entries that follow the same plan and written in the same style. This will be beneficial to learning about biological diversity.

#### **L.N. ANDREYEV, corresponding member of RAS:**

I wish to mention the role of botanical gardens in preservation of biological diversity. As far back as 1983, we published a book on rare plants grown in botanical

gardens of the Soviet Union. At that time there were 1117 of them. At present we have prepared the next edition of this book; in it there are already 1600 rare and endangered plant species, and if they were not grown in botanical gardens we would have lost a few important and interesting plants by now.

The main thing is that the collections in botanical gardens are not a goal in themselves, rather they are a basis for in-depth experimental studies, starting with taxonomy, morphology, anatomy and ending with physiology, biochemistry and even immunology of plants. These collections serve a number of generations of researchers. I could compare them to some extremely valuable equipment that has been used for a long time, for example, the telescope. Unfortunately, preservation of the collections is labor-intensive and complicated work.

The second purpose of botanical collections is an applied one, consisting of the search for new sources of drugs, food and industrial agents, as well as ornamental plants. Our arboretum, which contains more than 2,500 plant species, is among the largest in the world. The study of plants under the conditions in Moscow made it possible to recommend for landscaping in the capital more than 600 species of plants with high resistance to local conditions. Yet only about 100 species are currently used in the city's landscaping.

The third purpose of the collections is esthetic. Botanical gardens are instrumental in inculcating love of nature in people. Lack of such an opportunity leads to decline of social morality, growth of crime and other negative phenomena in our lives.

Unfortunately, the financial condition of the RAS Main Botanical Garden is on the verge of collapse. The shortage of funds constituted 114 million rubles in the fourth quarter of 1993. At the beginning of this year, the Moscow Regional Administration of Power System Management approved new, higher rates for electricity. Our present base funding is no longer sufficient to pay for municipal services, which presents the danger of loss of unique collections of plants gathered through the enormous labor of several generations of scientists, and will lead to irreplaceable loss to Russian and world science. It would be desirable for the RAS Presidium to provide for special funds for the upkeep of unique collections in botanical gardens and museums.

#### Academician R.V. PETROV:

When dealing with the basic nature of biology, inevitably concepts come to mind, such as genes, gene engineering, molecular aspects of cell life, and cell membranes. Today, I believe, everyone really felt that there is a second foundational level in biology that pertains to living things, their distribution on earth, diversity, population problems, etc. And these aspects are of colossal social importance.

I shall not discuss the extremely serious situation of botanical gardens, biological bases, preserves, expeditions, etc. I shall voice only one suggestion: to convene a

visiting session of the RAS Presidium on the grounds of the Botanical Garden and invite the press to attend, since it is so worried about the disastrous situation with nature in our country. Perhaps such a session should be specially dedicated to problems of botanical gardens, preserves, forest preservation, and preservation of biodiversity. This problem sounds rather abstract to many—dear me, some species are disappearing! Yet something greater is happening, the foundation of life is being shattered, the entire *balance of living matter*. I believe that this discussion will have a greater social impact than letters to the government.

The Presidium of the Russian Academy of Sciences, having heard and discussed the report of V.Ye. Sokolov, academician-secretary of the Department of General Biology, expressed approval of the performance of this department, aimed at further development of basic research in the area of general biology and ecology, application of its results in the national economy. A decree of the RAS Presidium notes that many scientific achievements of institutes of the Department of General Biology are on the world level of research; however, there is a lag in some directions due to insufficient and disorganized funding. The fact that work in a practical direction done at institutes of the Department has found application in agriculture, forest and fish industries, and in medicine, is rated as being positive. The work of the Department on development of the "Preservation of biological diversity" program has been approved. In view of the importance of succeeding in solving this problem, the RAS Presidium will ask the Russian Ministry of Science to increase funding for the State scientific and technical "Biological diversity" program.

The following recommendations are offered to the Department of General Biology: to expand work on developing specialized genetic data banks as one of the forms of preserving biodiversity of the nation and its gene pool; to include in the program of basic research development of the concept of ecological risk as the scientific basis for ecological expertise and ecological standard-setting. It is also suggested that the Department strengthen international contacts in order to receive hard currency funding for joint research (including studies at bases and preserves), that it participate more actively in broadcasting and popularizing scientific achievements, in ecological education of the public using mass media for this purpose.

Rossiyskaya akademiya nauk. Prezidium RAN, 1994

#### Comparative Characteristics of Preparations of *Yersinia pestis* Capsular Antigen F1 Obtained From Producer Strains With Different Lipopolysaccharide Structures

95TA01694 Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 31 Jan 92; after revision 14 Jun 92) pp 10-14

[Article by T.A. Gremyakova, V.N. Stepanshina, V.F. Negriy, O.V. Korobova, G.A. Anisimov, A.V. Apollonin,

and V.G. Likhoded, Applied Microbiology All-Russian Scientific Research Institute, Obolensk, Moscow Oblast, and Hydrobiot Biologically Active Substance Scientific Research Laboratory, Moscow]

[FBIS Abstract] A study compared the characteristics of preparations of F1 capsular antigen obtained from *Yersinia pestis* and from the bacteria *Escherichia coli* and *Salmonella minnesota* after the plasmid pFS1, which determines synthesis of the antigen F1, was introduced into them through transformation. The strains *Y. pestis* EV and *Y. pestis* 231 were used along with the recombinant strains *E. coli* HB101, which contains full-fledged lipopolysaccharide, and *S. minnesota* Re595, which contains glycolipid of the chemotype Re (containing the plasmid pFS1) instead of full-fledged lipopolysaccharide. The physical and chemical characteristics of the F1 antigen from each of the aforesaid sources were compared by various techniques, including determinations of their protein and carbohydrate levels by electrophoresis in 12 percent polyacrylamide gel with sodium dodecylsulfate, measurement of their immunochemical activity by passive hemagglutination and passive hemagglutination inhibition, and a randomized study to compare the amounts of protection provided by each F1 antigen to nonpedigree white mice. All three types of F1 antigen were found to include components with a molecular weight of 13,500 daltons and to have virtually the same isoelectric point (4.1 +/- 0.05 in two cases and 4.1 +/- 2.0 in the third case). The F1 antigen derived from *Y. pestis* EV had a lipopolysaccharide content of 12.8 +/- 0.9 percent versus lipopolysaccharide contents of 1.7 +/- 0.2 and 1.0 +/- 0.1 percent in the cases of the F1 antigens derived from *E. coli* HB101pFS1 and *S. minnesota* Re595 pFS1. The carbohydrate content of the antigen derived from *Y. pestis* EV was also much higher than that of the antigens derived from *E. coli* HB101pFS1 and *S. minnesota* Re595 pFS1 (21.1 +/- 1.0 percent versus 3.3 +/- 0.2 and 2.0 +/- 0.3 percent). From the standpoint of their physicochemical and immunochemical properties, the capsular antigens isolated from *E. coli* HB101pFS1 with a full-fledged lipopolysaccharide structure and *S. minnesota* Re595 pFS1 were determined to be identical to those of the antigen derived from *Y. pestis* EV. The strain *S. minnesota* Re595 pFS1 had a higher yield of F1 antigen (9.3 +/- 0.3 mg/ml) than either *E. coli* HB101 pFS1 (6.7 +/- 0.2 mg/ml) or *Y. pestis* EV (0.3 +/- 0.1 mg/ml). The capsular F1 antigen obtained from *S. minnesota* Re595 pFS1 had higher antigen and protective activity than did antigens from the other two bacterial strains: When administered to white mice in an immunizing dose of 25 µg, it was determined to have a median lethal dose [LD<sub>50</sub>] of (32 +/- 9) x 10<sup>3</sup> and to protect against death for an average of 10.4 +/- 1.0 days (versus an LD<sub>50</sub> of 10 +/- 3 and average number of days of protection against death of 8.4 +/- 0.7 in the case of vaccine derived from *Y. pestis* EV). Figure 1, tables 3; references 16: 7 Russian, 9 Western.

### Heterogeneity of Populations of Recombinant Strain *Escherichia coli* KS 1561, a Producer of Thermolabile Enterotoxin, During the Process of Submerged Culturing

957A0169B Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 15 Oct 92) pp 23-26

[Article by L.D. Martynenko, A.V. Aleshukina, L.P. Zemlynskina, and Yu.V. Yezepchuk, Epidemiology, Microbiology, Parasitology, and Hygiene Scientific Research Institute, Rostov-na-Donu, and Epidemiology and Microbiology Scientific Research Institute imeni N.F. Gamaleya, Russian Academy of Medical Sciences, Moscow]

[FBIS Abstract] The recombinant bacterial strain *Escherichia coli* KS 1561 is a producer of thermolabile enterotoxin. A study examined the heterogeneity of *E. coli* KS 1561 populations and their biological properties during the process of submerged culturing. The studies were performed on the genetically engineered strain *E. coli* KS 1561 N 10, which contains the plasmid LT 307. The strain was grown in Endo's medium containing tetracycline in a concentration of 15 µg/ml. The population profile study performed established that in Endo's medium containing the aforesaid concentration of tetracycline, the inoculate dissociates and eventually forms two populations. At the beginning of the culturing process, the ratio of the two populations (designated P1 and P2) is 97:3. Population heterogeneity increases during the course of the culturing process, with dissociation peaking 2 hours after initiation of the culturing process and continuing until the fifth hour, at which time a phase of intensified growth begins. The exponential phase is characterized by an increase in the number of cells in population P1 and a decrease in the size of population P2 that is likely linked to the formation of a leading generation of cells from the population P2. Microscopic analysis of culture samples confirmed that the cells underwent significant morphological changes during the culturing process. In the lag phase and in the phase of intensified growth, the cells were in the shape of medium-sized straight rods with round ends and were arranged singly. In the stationary phase, gigantic rods appeared that were 3 to 5 times larger than the cells in the starting culture. The walls of approximately one-third of the dividing cells remained fastened to one another, forming chains three to five cells long. A study of subcultures' biochemical properties established that the bacteria of population P1 were incapable of fermenting lactose and possessed a high degree of toxin production, whereas the cells of population P2 were capable of fermenting lactose and produced a lesser quantity of toxin. The biological activity of bacterial cell lysate subcultures was determined in a test of discharge from an infected mouse's paw. The test confirmed that P1 cells synthesize more enterotoxin than P2 cells do (148 mg versus 96 mg). The serologic activity of the

bacterial cells' lysate was assessed as weakly positive and recorded in only two cases, i.e., in the bacterial cell lysate of subcultures of P1 cells obtained (1) at the end of the phase of exponential growth and (2) at the beginning of the stationary phase. Figures 2; references 10: 9 Russian, 1 Western.

### Search for and Isolation of *Francisella tularensis* Antiphagocyte Factor

957A0169C Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 15 Aug 91; after revision 8 Dec 92) pp 26-28

[Article by L.V. Larionova, Antiplague Scientific Research Institute, Russian Federation State Committee for Sanitary-Epidemiological Oversight, Rostov-na-Donu]

[FBIS Abstract] A study examined factors stimulating and inhibiting phagocytosis in *Francisella tularensis*. A fraction of *F. tularensis* water-saline extract that was 55-60 percent saturated with ammonium sulfate was split into individual components by the method of preparative disk electrophoresis in 7.5 percent polyacrylamide gel. A total of 10 preparations were thus obtained. Five of them reacted with specific equine antitularemia serum, forming at least two precipitation zones. The substance preventing intracellular digestion of bacteria was localized through a study of the said preparations' effect on completion of phagocytosis by guinea pig peritoneal macrophages. The antiphagocytic activities of the five components (when administered in a dose of 200 µg/ml) ranged from -0.12 (the second and fourth components extracted from the gel) to -0.95 (the fifth component extracted from the gel) as opposed to -0.11 in the case of the strain *F. tularensis* 16 Gayskiy. The fifth component extracted was determined to contain 0.845 grams of protein and 0.15 grams of carbohydrate per liter. In electrophoretic separation of the preparation in polyacrylamide gel, two bands were discovered that were stained by a solution of Coumassie R-250 (for proteins) and alcian blue (for polysaccharides). The electrophoregrams were not stained by toluidine blue (for nucleoproteins and mucopolysaccharides). Nor were they stained by a mixture of pyronin-methyl green (for nucleic acids), Sudan black, or iodine solution (for lipoproteins). The said preparation's antigens had molecular weights of approximately 92 and 66 kilodaltons. Analysis by isoelectric focusing in polyacrylamide gel in the pH range from 3.5 to 10 revealed two spots with isoelectric points in the 4.6-5.8 range. On the basis of the aforesaid results, it was concluded that the preparation suppressing intracellular digestion of *F. tularensis* by macrophages is a glycoprotein. The function of suppression of phagocytosis of *F. tularensis* by guinea pig peritoneal macrophages depends on the protein portion of the preparation. Figures 2, table 1; references 9: 3 Russian, 6 Western.

### Cloning and Expression of the β-Hemolysin Gene of *Staphylococcus aureus*

957A0169D Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 5 May 92) pp 28-33

[Article by V.Ye. Katerov, V.I. Golukov, A.A. Tomolyan, K. Shalen, L. Yensen, I. Mikula, and I. Smola, Epidemiology and Microbiology Scientific Research Institute, Russian Academy of Medical Sciences]

[FBIS Abstract] The gene coding the synthesis of β-hemolysin (phospholipase C) was cloned from the *Staphylococcus aureus* strain 126/89. The genome bank of *S. aureus* was obtained by incomplete digestion of the bacteria's chromosomal DNA by nuclease Sau3A with subsequent ligation at the BamHI sites to the arms of the phage DNA of the vector λL47.1. After in vitro harvesting of the phages, those phages that produce β-toxin were seeded for selection. β-Hemolysin's ability to induce total lysis of bovine erythrocytes sensitized by group B streptococci cyclic adenosine monophosphate [cAMP] was used to detect those recombinant phages carrying the gene *plc*. One of the phagal clones discovered during the screening process to induce complete lysis of erythrocytes surrounding colonies, i.e., BT1-3, was selected for further study. The recombinant plasmid pBT1 was found. It was determined to contain a 2.7-kilobase [kb] insertion in pUC8 and to express β-toxin in *Escherichia coli*. An *E. coli* clone containing the recombinant plasmid and inducing erythrocyte lysis was obtained and demonstrated to be capable of synthesizing phospholipase C. Samples of the *E. coli* with the recombinant plasmid pBT1 were found to have two additional proteins that are not present in samples of *E. coli* with pUC8 but that are clearly visible in the culture fluid of *S. aureus*. The said proteins' molecular weights were 40 and 37 kilodaltons [kD] respectively. A comparison of the absolute values of β-toxin produced by the recombinant *E. coli* and *S. aureus* established that the *E. coli* with pBT1 releases three times the amount of β-toxin to the culture liquid as the producer strain *S. aureus* 126/89 does. Inside the *E. coli* cells, β-toxin activity exceeds the total activity of *S. aureus* by a factor of 250. At the same time, the control strain *E. coli* JM109 with pUC8 did not manifest any hemolytic activity whatsoever. The complete nucleotide sequence of the gene *plc* (which codes a peptide consisting of 333 acid radicals) was mapped after recloning the 2.7-kb fragment into the vector plasmid pGEM7zf(+). The enzymatic and molecular characteristics of the phospholipase C (β-hemolysin) obtained from the genetically engineered producers were found to be identical to those of the natural producers. Analysis of the nucleotide sequence indicated that the phospholipase C gene is conservative and varies little from one *Staphylococcus* strain to another. Figures 3; references 17: 1 Russian, 16 Western.

**Ecological and Epidemiological Aspects of the Spread of *Vibrio parahaemolyticus* in a Fresh Water Region**

957A0169E Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 21 Feb 92; after revision 3 Aug 92) pp 49-51

[Article by A.V. Boyko, N.P. Pogorelova, and T.M. Zhigareva, Astrakhan Affiliate, Central Scientific Research Institute of Epidemiology]

[FBIS Abstract] For the first time, *Vibrio parahaemolyticus* has been isolated in a fresh water region of Russia. *V. parahaemolyticus* was identified in 1987-1990 in 6 (1.2 percent) of 488 patients entering Astrakhan Oblast Infectious Disease Hospital with symptoms of acute intestinal illness during the study period. In addition, *V. parahaemolyticus* was discovered in 2 (2.8 percent) of 72 samples of sturgeon eggs and 3 (3.8 percent) of 79 samples of bottom sediment from fresh water reservoirs. No *V. parahaemolyticus* was detected in any of 121 water samples taken from fresh water reservoirs in the area, however. The simultaneous presence of *V. parahaemolyticus* in the bottom sediment of the area's fresh water bodies and absence of the bacteria in the water itself was explained by the fact that *V. parahaemolyticus* is most active when salt concentrations in water are between 0.1 and 1.2 M and that a set of factors existing in the sludge (sediment) at the bottom of the Astrakhan Oblast's fresh water bodies are likely conducive to the growth and breeding of *V. parahaemolyticus* even though the fresh water of the said water bodies is not. This sludge has thus likely created an ecological niche for circulation of *V. parahaemolyticus*. This is especially true in the Volga delta. Another factor that is important from the standpoint of fluctuations in the incidence of infections caused by *V. parahaemolyticus* is the fact that the Volga's salt content fluctuates from year to year. It has been established that in some years, *V. parahaemolyticus* is the etiologic agent of up to 9.1 percent of all cases of acute enteric infections occurring during the summer in the territory of Astrakhan Oblast. Circulation of *V. parahaemolyticus* in the oblast's territory is most likely as follows: sea water → fish → humans → sewage → fresh water → fish. Figure 1, table 1; references 14: 8 Russian, 6 Western.

**Immunodiagnosis of Melioidosis by a Solid-Phase Variant of Radioimmunoassay**

957A0169F Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 28 Feb 92; after revision 18 Dec 92) pp 69-73

[Article by N.N. Piven, A.D. Manolov (deceased), L.F. Zykin, A.Ye. Zamarin, V.V. Manankov, and A.T. Yakovlev, Volgograd Antiplague Scientific Research Institute]

[FBIS Abstract] The most commonly used methods of serodiagnosis of melioidosis at the present time (i.e., the agglutination, complement binding, and indirect hemagglutination reactions) are often ineffective. Preliminary data have indicated that the surface antigens 6 and d (on which synthesis of specific immunoglobulins in the body of laboratory animals infected with *Pseudomonas pseudomallei* primarily occurs) are promising for use in developing a better way to diagnose melioidosis. In view of these data, an attempt was made to develop a radioimmunoassay method of diagnosing melioidosis based on the antigens [Ag] Ag6 and Ag6 + d. Ag6 + d complex was prepared from acetone-dried cells of *P. pseudomallei* 57576 as follows: A suspension of dried cells in 0.15 M of an NaCl solution (pH 7.0) in a concentration of 15 g/l was subjected to ultrasound treatment at 100 W for 15 minutes at a frequency of 20 kHz. The cell detritus was separated by centrifugation at 15,000 g. Ammonium sulfate was added to the resultant supernatant until a 40 percent concentration was achieved. The precipitate was dissolved in 0.15 M of NaCl solution and filtered on Sephadex G-25. The resultant antigen complex was subjected to chromatography in a phosphate buffer solution (pH 7.2) in a column with AsA-44 ultragel. Melioidosis infection was modeled by using a set of 13 melioidosis infective agents with different antigen profiles and levels of virulence and a variety of laboratory animals with varying levels of sensitivity to melioidosis infective agent: golden hamsters, nonpedigree white mice, guinea pigs, and white rats. All were infected intraperitoneally with one-half the median lethal dose of the various melioidosis infective agents. A solid-phase version of radioimmunoassay involving immobilization of nonlabeled Ag6 and Ag6 + d antigen complexes and detection of specific immunoglobulins by <sup>125</sup>I-labeled protein A was developed. Ag6 and Ag6 + d concentrations of 1 and 10 µg/ml, respectively, and immune serum dilutions between 1:10 and 1:10,000 were determined to be optimal for the solid-phase radioimmunoassay technique. Analysis of the sera of the infected animals established that the optimum serum dilution is 1:20. The proposed radioimmunoassay was found to be highly sensitive and able to detect antibodies in 70.4 percent of experimental serum samples tested. In tests of samples of serum taken exclusively from ill laboratory animals, antibody was detected in 80.6 percent. In comparative tests, the new solid-phase radioimmunoassay method proved to be more sensitive and more specific than conventional immunoassay methods (the hemagglutination reaction and enzyme immunoassay) in detecting specific immunoglobulins in laboratory animals infected with melioidosis infecting agent. The new radioimmunoassay method based on Ag6 and Ag6 + d makes it possible to classify strains causing melioidosis as being of either the Asian or Australian serovar of *P. pseudomallei*. Tables 4; references 13: 3 Russian, 10 Western.

**Lectin Activity of the Mussel Bioglycan Mytilan and Its Effect on Microbial Adhesion to Macroorganism Cells**

957A0169G Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLLOGII in Russian No 3, May-Jun 94 (manuscript received 19 Feb 92) pp 86-88

[Article by T.S. Zaporozhets, N.N. Besednova, R.G. Ovodova, and V.Ye. Glazkova, Epidemiology and Microbiology Scientific Research Institute, Siberian Department, Russian Academy of Medical Sciences, and Pacific Ocean Institute of Bioorganic Chemistry, Far Eastern Department, Russian Academy of Sciences, Vladivostok]

[FBIS Abstract] Mytilan is a high-molecular-weight bioglycan that consists of a polysaccharide component ( $\alpha$ -1,4-D-glucan) and a small amount (less than 5 percent) of protein. Mytilan has been isolated from the mussel *Crenomytilus grayanus* and been demonstrated to be capable of boosting animals' nonspecific resistance to selected experimental infections. One of the mechanisms of mytilan's protective action is its effect on bacterial adhesion to the cells of the macroorganism. Mytilan's lectin activity and the effect of that activity on microbial adhesion to macroorganism cells was examined by a micromodification of the hemagglutination reaction. The bacterial strains *Escherichia coli* 93, *Staphylococcus aureus* Gure, and *Pseudomonas aeruginosa* 213 were used in experiments to determine mytilan's effect on microorganism adhesion to human erythrocytes. All three strains of microorganisms proved to have high degrees of adhesiveness. The median indices of adhesion of *E. coli*, *S. aureus*, and *P. aeruginosa* in control erythrocytes (i.e., erythrocytes incubated with microorganisms) were  $5.1 \pm 0.7$ ,  $4.48 \pm 0.68$ , and  $5.08 \pm 0.8$ , respectively. When erythrocytes were treated with mytilan (in a concentration of  $50 \mu\text{g/ml}$ ), the median indices of adhesion of *E. coli*, *S. aureus*, and *P. aeruginosa* decreased by 26, 33, and 52 percent respectively (i.e., to  $3.74 \pm 0.22$ ,  $2.98 \pm 0.18$ , and  $2.39 \pm 0.5$ , respectively). Incubating mytilan with the erythrocytes and microorganisms and then combining them for 30 minutes at  $37^\circ\text{C}$  resulted in an even greater decrease in the microorganisms' adhesion properties. Specifically, the median indices of adhesion of *E. coli*, *S. aureus*, and *P. aeruginosa* to human erythrocytes decreased by 51, 38, and 68 percent, respectively (i.e., to  $2.2 \pm 0.24$ ,  $2.74 \pm 0.36$ , and  $1.88 \pm 0.04$ , respectively). The following mechanisms of mytilan's effect on microbial cell adhesion were hypothesized: Because mytilan possesses the activity of a galactose-specific lectin, it screens the lectin receptors of erythrocytes' membranes, thereby significantly reducing bacterial adhesion capability. When bacteria are treated with mytilan, binding of the lectin portion of mytilan by the terminal radicals of the sugars of the microbial cell's outer membrane is possible. Consequently, preliminary separate incubation of mytilan with erythrocytes and microorganisms followed by their

combination so that they can interact results in an even greater decrease in microbes' ability to adhere to erythrocytes. Table 1; references 6: 5 Russian, 1 Western.

**Immunologic Criteria of Selecting Military Personnel for Service Under Extreme Conditions**

957A0169H Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLLOGII in Russian No 3, May-Jun 94 (manuscript received 10 Mar 92) pp 92-96

[Article by B.B. Pershin, S.N. Kuzmin, and N.N. Filatov, Immunoprofilaktika Medical Engineering Center, Russian Academy of Medical Sciences, Moscow]

[FBIS Abstract] The immune response of Russian soldiers drafted into service in Afghanistan was examined for the purpose of developing immunologic criteria for selecting individuals for full-fledged execution of military duties under extreme conditions. In 1984, a total of 1,825 men in 3 different groups were studied. The first group consisted of 450 men between the ages of 18 and 24 years who had served in the military for 3 months and who were in a special "quarantine" subdivision. The second group consisted of 800 men between the ages of 19 and 22 who had served in the military for 1 year and who were in a tank regiment. The third group consisted of 578 men between the ages of 15 and 21 years who were attending a vocational-technical school. The men in the first group had completed special training for troops ordered into military action in Afghanistan, the men in the second group (the comparison group) were adapted to military service and were completing their service inside Russia, and the men in the third group were civilians with no military service. All three groups lived in the same territory in a southern military district. Overall morbidity in all of the groups was analyzed for 3 months before the beginning of the study. The men's immune systems were evaluated through a series of tests studying factors important to humoral and local immunity. All results were subjected to statistical processing. Disturbances in the systems of humoral and local immunity were discovered among the members of all three groups; however, the number of cases of immunodeficiency in the men in group 1 significantly exceeded the numbers in groups 2 and 3. The IgA levels of the men in group 1 were significantly lower than those of the men in groups 2 and 3 ( $1.84 \pm 0.07$  versus  $2.11 \pm 0.05$  and  $2.13 \pm 0.07$ ). The IgG levels of the men in group 1 were also significantly lower than those of their counterparts in groups 2 and 3 ( $11.20 \pm 0.32$  versus  $13.48 \pm 0.41$  and  $14.60 \pm 0.40$ ). No significant levels in IgM blood levels among the men in the different groups were noted, however. In addition, the men in group 1 had higher titers of anamnestic antibodies to the infective agents of pertussis, diphtheria, and tetanus than did their counterparts in groups 2 and 3. Specifically, the average levels of the anamnestic antibodies to pertussis in the three groups were as follows: group 1,  $123.8 \pm 20.96$ ; group 2,  $55.7 \pm 9.94$ ; and group 3,  $44.3 \pm 2.66$ . Average levels

of anamnestic antibodies to diphtheria in the three groups were as follows: group 1, 847.1 +/- 342.08; group 2, 163.9 +/- 39.13; and group 3, 152.2 +/- 10.65. Average levels of anamnestic antibodies to tetanus in the three groups were as follows: group 1, 1,463.8 +/- 330.12; group 2, 339.2 +/- 39.13; and group 3, 213.9 +/- 42.63. Overall morbidity was also significantly higher among the men in group 1 than among the men in either group 2 or group 3: 31.1 percent of the men in group 1 suffered from some type of illness during the study versus 8.4 percent of the men in group 2 and 9.3 percent of the men in group 3. In view of the aforesaid evidence of the detrimental effects of military service under extreme conditions on the immune system, it was recommended that soldiers identified as having "serious" or "average" levels of immunodeficiency be exempted from service in areas of military activity associated with a rather high risk of morbidity. Tables 4; references 17: 13 Russian, 4 Western.

#### **Effect of Antigen Fractions of the Outer Membrane of *Francisella tularensis* on Selected Indicators of T-Cell Immunity**

957A0169I Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI in Russian No 3, May-Jun 94 (manuscript received 18 Jan 92) pp 100-103

[Article by D.V. Skatov, V.G. Galaktionov, L.N. Semenkova, and V.S. Khlebnikov, Immunology Institute, Biopreparat State Firm, Lyubuchany, Moscow Oblast]

[FBIS Abstract] A study examined the effect of selected antigen components of the outer membrane of *Francisella tularensis* on such forms of T-cell reactivity as delayed-type hypersensitivity and lymphocyte proliferation during blast transformation and in a mixed lymphocyte culture. Antigen fractions of different molecular weights were obtained from the extracts *F. tularensis* strain A'Cole by separation on a column filled with Sephadex G-200. The immunomodulating effect of four gel filtration antigen fractions of *F. tularensis* were studied both in the phase of antigen induction and formation of T-effectors of delayed-type hypersensitivity and in the phase of resolution of the reaction. The molecular weights of the four gel filtration antigen fractions were as follows: 1, >200 kilodaltons [kD]; 2, 85 to 200 kD; 3, 35 to 85 kD; and 4, 15 to 35 kD. The various gel filtration antigen fractions had a marked effect on delayed-type hypersensitivity. Fractions 1 and 3 reduced the response by 30-40 percent ( $p < 0.05$ ) regardless of the phase of the antigen's introduction and concentration. Fraction 2 had the greatest inhibiting effect, inhibiting delayed-type hypersensitivity by a factor of 2 ( $p \leq 0.05$ ). Factor 4, on the other hand, stimulated delayed-type hypersensitivity both in the induction phase (by 30 percent) and in the effector phase (by 20-30 percent) ( $p \leq 0.05$ ). It was hypothesized that the gel filtration antigen fractions of *F. tularensis* modulate both the process of maturation of T-effectors of delayed-type

hypersensitivity (the induction phase) and the activity of mature effectors (the resolution phase). Experiments examining the effect of *F. tularensis* gel filtration antigen fractions on blast transformation of T-lymphocytes established that low doses of the fractions have no effect on lymphocyte proliferation. As the concentrations of fraction 1 and a complex of fractions 2 + 3 are increased to 10  $\mu$ g/ml, however, they reduce lymphocytes' proliferative response by 35 and 20 percent respectively. At a concentration of 50  $\mu$ g/ml, total cancellation of the reaction under the effect of either fraction 1 or fractions 2 + 3 is observed. Gel filtration antigen fraction 4, on the other hand, induced a threefold intensification in lymphocytes' proliferative response as compared with controls in concentrations of 10 and 50  $\mu$ g/ml. The *F. tularensis* gel filtration antigen fractions 1 and 2 + 3 thus had an inhibiting effect on processes associated with polyclonal activation of T-lymphocytes, whereas fraction 4 had a marked stimulating effect on the same processes. Figures 4; references 9: 2 Russian, 7 Western.

#### **Situation Regarding the Cholera Epidemic Worldwide: Morbidity Analysis and Trends**

957A0170A Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI in Russian No 3, May-Jun 94 (manuscript received 29 Jul 93) pp 34-39

[Article by G.G. Onishchenko, Yu.M. Lomov, E.A. Moskvitina, E.G. Usenko, A.G. Varivoda, A.Yu. Parfenov, and Yu.G. Kireyev, Rostov-na-Donu Antiplague Scientific Research Institute; first paragraph is verbatim ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGI English abstract]

[FBIS Translated Text] The analysis of cholera morbidity throughout the world over the period 1988-1992 indicates the existence of a tendency toward an increase in morbidity due to epidemic outbreaks in the countries of South and Central America and in Africa. Using data in the literature, attempts have been made to elicit the cause of the sudden appearance and spread of cholera in South America. The increase in cholera morbidity in Africa is associated with the activation of cholera in endemic foci and intensified migration caused by military conflicts in the countries of Central and East Africa. Cholera morbidity in Asia appears to be declining; however, large outbreaks of cholera, as well as diarrheal diseases clinically similar to cholera and caused by *Vibrio cholerae* non O1, serogroup 139, have been recorded. In Europe, including Russia, cholera outbreaks and sporadic cases, mainly imported, have been reported. The prognosis of the cholera situation remains unfavorable due to the activation of epidemic processes and the constant risk of the infection being imported to any country of the world.

The cholera problem remains critical in connection with its current spread throughout countries and continents.

The purpose of this work is to determine the cholera situation and trends in cholera morbidity throughout the world in 1988-1992.

#### Materials and Methods

Information from the Cholera database, which is a problem-oriented factual database regarding morbidity due to cholera throughout the world based on WHO reports since 1961 and cases of cholera in Russia and other CIS countries, was used. The Epidanaliz programs, which were developed at the Central Scientific Research Institute of Epidemiology of the Russian Federation State Committee for Sanitary-Epidemiological Oversight, were also used to determine morbidity levels in different territories, trends, and other characteristics of the epidemic process.

#### Results and Discussion

Analysis of information contained in the Cholera database made it possible to establish that according to official WHO estimates, 2,826,276 cases of cholera were recorded within the 32 years of the seventh pandemic (1961-1992). The greatest number of cases of infection, i.e., 1,358,480, was noted in Asia.<sup>1</sup>

Despite the fact that the pandemic reached the Americas 20 years later than it reached Africa, 727,455 cases of cholera were recorded in American countries in just 1991 and 1992. Approximately the same number, i.e., 729,831 cases, were recorded in Africa. The swiftness of

the epidemic's development in South and Central America led researchers to the conclusion that in the said regions, it has sometimes not been successfully controlled.<sup>2,3</sup>

An analysis of the structure of morbidity due to cholera by continent during the seventh pandemic has established that cholera cases have been distributed as follows: Asia, 48.1 percent; America, 25.7 percent; Africa, 25.8 percent; Australia and Oceania, 0.2 percent; and Europe, 0.2 percent.

Figure 1 presents the dynamics of morbidity due to cholera along with the trend in the development of the epidemic process in 1988-1992. The increase in morbidity is linked to the spread of infection to the Americas and activation of cholera in Africa and to the higher relative indicators on the two continents in 1991 and 1992 (Figure 2).

D. Colfier's prognosis<sup>4</sup> regarding the possible recording of millions of cases of cholera in the countries of South and Central America has not yet been fully justified. Since 1992, however, increases in the number of cases of infection as compared with the number recorded in 1991 have been noted in the following countries and elsewhere (figures in parentheses are for 1991 and 1992, respectively): Bolivia (206 and 22,250); Brasil (1,567 and 30,309); Guatemala (3,674 and 15,395); and El Salvador (947 and 8,106). As previously, the greatest number of cholera patients was found in Peru (322,562 in 1991 and 212,642 in 1992). Lethality throughout the continent as

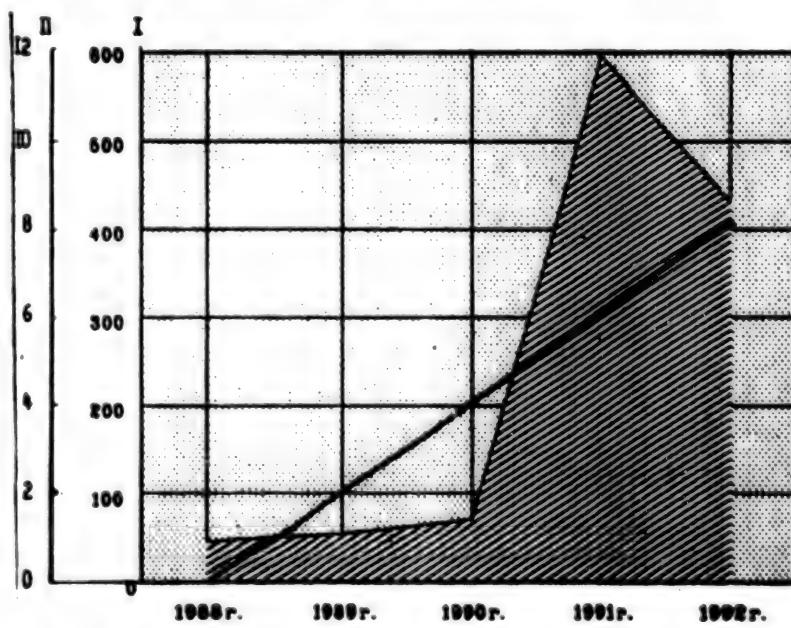
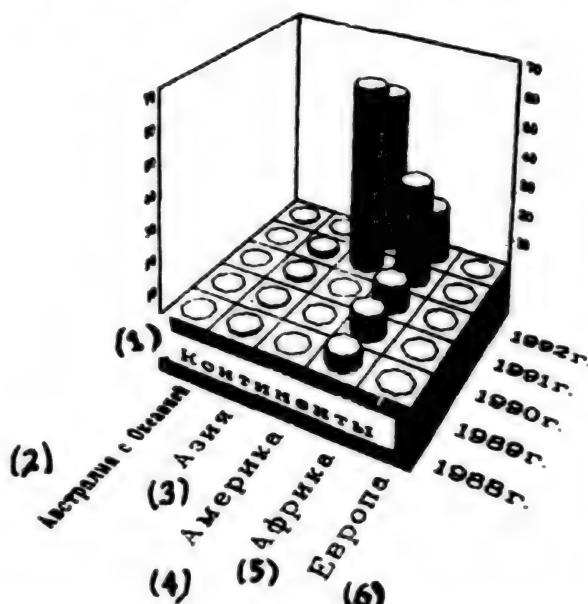


Figure 1. Dynamics and trend of morbidity due to cholera throughout the world. Years are plotted along the x-axis, and numbers of cases are plotted along the y-axis.

Key: I, morbidity indicators in absolute numbers; II, morbidity indicators per 100,000 population members.)

a whole in 1991 and 1992 was at a level of 1.0 percent but equaled 2.7 percent in Argentina and 4.8 percent in the Honduras in 1992.



**Figure 2. Morbidity due to cholera on the different continents. (In Figures 2 through 4, morbidity indicators per 100,000 population are plotted along the y-axes.)**

Key: 1, continents; 2, Australia and Oceania; 3, Asia; 4, America; 5, Africa; and 6, Europe.)

In the United States and Canada, 147 cases of cholera were recorded during the analysis period, which is higher than the number of cases noted in the said countries between 1964 and 1990.

The reason for the sudden appearance of the current pandemic in South America is open to hypothesis and conjecture. Among the main questions of interest to researchers is how *Vibrio cholera* eltor was brought in.

The origin of the first cases was not discovered. The occurrence of cases in Pacific Ocean seaports led WHO specialists to hypothesize that the infecting agent was carried in by seagoing vessels from the Pacific Ocean region.<sup>2</sup> The possibility that the cholera germ has penetrated South America through the hulls or ballast layer of water of Chinese cargo ships has not been excluded.<sup>7</sup> In addition, the use of genetic and molecular biology methods, including sequencing, provided a key to the epidemic strains' origin.<sup>7</sup>

In 1991, J. Wachsmuth demonstrated that the toxigenic *Vibrio cholera* eltor previously isolated in the United States and on the coast of the Gulf of Mexico was different from most strains of *Vibrio cholera* eltor isolated during the seventh pandemic in African and Asian countries and in the Pacific Ocean region. The strains on

the coast of the Gulf of Mexico was hemolysis-positive, contained the phase Vca-3, and had a unique cholera toxin gene profile.<sup>10</sup>

Like the strains from the coast of the Gulf of Mexico, the toxigenic *Vibrio cholera* eltor isolated in Peru, Ecuador, and Colombia belonged to the serotype Inab; however, they not hemolytic, do not contain the phage Vca-3, and have a *Hind* III in their cholera toxin gene. The South American strains were identical to one another and to the cholera germ isolated in 1990 on the Truk Islands and in Malawi. It was concluded that the cholera germ isolated during the current pandemic in Peru and other countries in South America is not linked to the clone previously discovered on the coast of the Gulf of Mexico. They represent a clonal group of strains that have spread in the Western Hemisphere and are identical to the pandemic strains that continue to cause large epidemics and outbreaks in Africa and Asia, as well as in the Pacific Ocean region.<sup>10</sup>

In 1992, S. Farugue and I. Albert compared strains of *Vibrio cholera* eltor isolated in 1991 during the cholera outbreaks in Bangladesh and Ecuador. The study was conducted by using Southern blot hybridization with the restriction endonuclease *Hind* III and a probe representing a cloned rRNA gene. All of the strains were established to be identical from the standpoint of their hybridization profiles. This confirmed the genetic connection and identical nature of the strains causing the epidemics on two continents far removed from one another.<sup>6</sup> The resultant data confirmed I. Wachsmuth's view that the cholera outbreak in South America was caused by the *Vibrio cholera* eltor that caused the seventh pandemic.

The progressive pandemic spread of cholera continues. Researchers are undoubtedly concerned by such questions as why the infection has spread so rapidly and how *Vibrio cholera* eltor carried into an area "one day" could spread so widely and ultimately cause large epidemics. American specialists note that neither travel restrictions nor quarantine measures regarding cholera patients have been able to prevent the spread of cholera primarily because of the high level of asymptomatic infection. After infection is carried into an area, a period of intensive transmission generally follows. As a result, more than 1 percent of a local population can become infected within the course of a month, as for example, happened in some regions of Panama.<sup>3</sup>

Some believe that cholera spread along the coast into Peru and into neighboring countries through infected fish and then moved inland in the manner previously observed in Africa. The explosive nature of the epidemic process in cities was linked to contamination of municipal water supplies.<sup>11</sup> Instances of cholera being carried into the United States, especially in the ports of Mobile (Alabama) and Gulfport (Mississippi) with the ballast and hull water of cargo ships arriving from Brasil, Colombia, and Chili have been discovered.<sup>8</sup> Water has not been the sole route of the infection's transmission, however. Consumption of vegetables, especially the cabbage group during a flood of

sewage into Peru, is also a risk factor. It has been suggested that improperly cooked vegetables have also contributed to cholera's spread in Chili. In Ecuador, spread of the infection is linked to contaminated mollusks, and crabs carried out of the country by tourists have caused two cholera outbreaks in the United States. In the early stages of the epidemic in Peru and Ecuador, raw fish and other seafood were a source of infection. Foods and beverages sold on streets and foodstuffs consumed without repeated heat treatment are risk factors.<sup>2,9</sup>

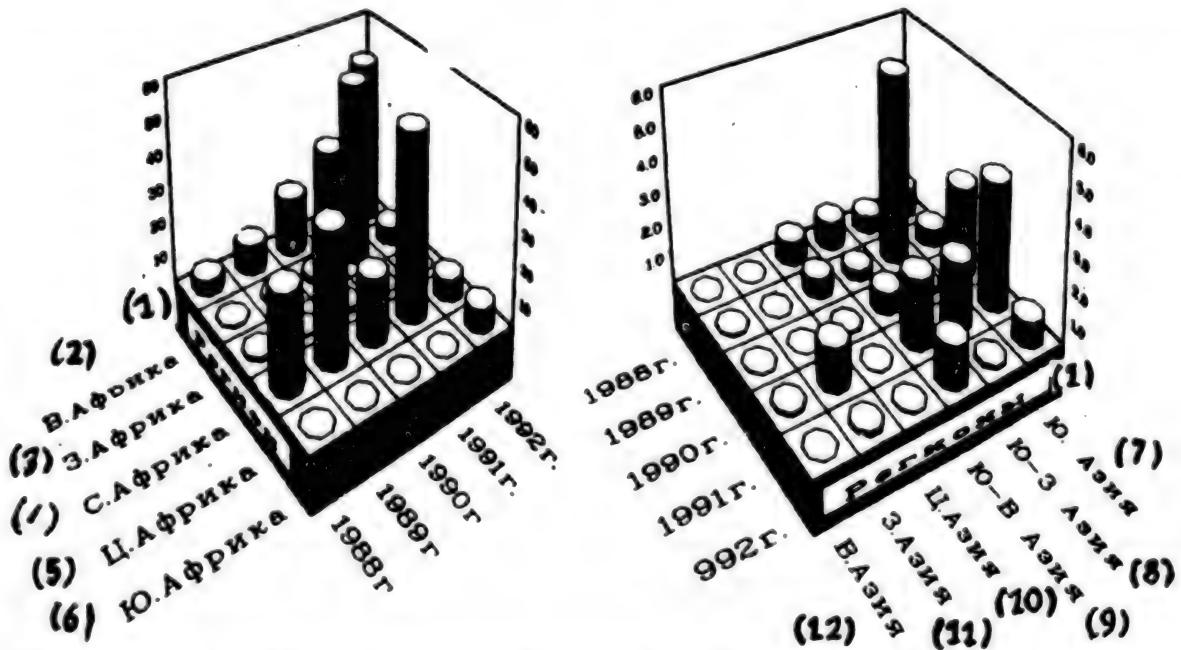
The virtual round-the-clock recording of cholera infection in a number of countries (Peru, Brasil, Ecuador, Panama, and El Salvador) and cholera's pronounced seasonal peaks have led researchers to conclude that cholera has become rooted on the subcontinent as an endemic infection.<sup>7</sup>

The isolation of cholera germ in oysters and the intestinal contents of fish in the gulf near Mobile (United States) must not be forgotten. The strains were similar to the Latin American strains from the standpoints of biovar, phagotype, and serovar. The two types of cholera germ were also shown to be identical by genetic analysis using probes for rRNA and cholera toxin genes. U.S. public health agencies are worried about the possibility of the said strains becoming rooted in the Gulf of Mexico.

In addition to the prediction that the infection will remain in South and Central America for years, specialists considering the long-range cholera situation are speaking of its spread to new regions in the Caribbean Basin, Amazon Basin, and Atlantic coast.

On the African continent, a trend toward increasing morbidity has been developing since 1988 (a +24.6 percent growth rate) owing to epidemics and large outbreaks of cholera in countries in virtually all regions of Africa: eastern (Zambia, Mozambique, Uganda), central (Angola, Cameroon), western (Benin, the Ivory Coast), and southern (Swaziland) (Figure 3) with a lethality ranging from 1.3 to 30 percent. In characterizing the epidemic situation in Africa, one must note the formation of persistent endemic foci in Liberia, Nigeria, Mauritania, Burundi, Kenya, Tanzania, Zaire, and Cameroon since *Vibrio cholera* eltor was first brought to the continent in 1970. Specialists from the WHO have stated they were absolutely unable to understand the factors facilitating the unprecedented enormous epidemic of 1991, during which 153,367 cases of cholera (including 13,998 with lethal outcomes) were recorded.<sup>3</sup> Among the main problems in Africa in the past few years are the periodic problems related to military conflicts and social upheavals and migrations of large contingents of the population, especially from Mozambique and Angola into Zimbabwe, Malawi, and other countries. One consequence of this has been the overcrowding of refugee camps, where risk factors become everyday occurrences during cholera outbreaks.

An analysis of the dynamics of morbidity due to cholera on the continent of Asia (after activation of the epidemic process in 1990 and 1991) revealed a trend toward a decrease in morbidity, i.e., a morbidity rate of -19.1 percent. The highest level of morbidity during the analysis period



Figures 3 (left) and 4 (right). Morbidity due to cholera in various regions of Africa and in various regions of Asia.

Key: 1, regions; 2, eastern Africa; 3, western Africa; 4, northern Africa; 5, central Africa; 6, southern Africa; 7, southern Asia; 8, southwestern Asia; 9, southeastern Asia; 10, central Asia; 11, western Asia; and 12, eastern Asia.

was noted in countries in southern (Nepal, Butan, India), southwestern (Iran), and southeastern (Indonesia, Malaysia, and Vietnam) regions of the continent (Figure 4). Epidemics and outbreaks in the endemic territories of India, Indonesia, Malaysia, Thailand, and Vietnam are dictating the dynamics of the epidemic process throughout the entire continent. It should be noted that cases of the infection being carried from Asia to countries in Europe, the Americas, and Australia are noted each year not only in connection with the traditional trade and tourism ties but also with the rather stable ethnic routes of immigration into Great Britain, Germany, and The Netherlands that have developed in recent decades as a result of migration processes. After a rather long hiatus, Afghanistan informed the WHO of a large cholera epidemic in 1993.

**WHO information about outbreaks of diarrheal illnesses caused by cholera germ of the non O1 0139 serogroup in countries in southern Asia (India and Bangladesh) is causing alarm.<sup>5</sup>**

In 1993, outbreaks of these diarrheal illnesses, which are clinically similar to cholera, have acquired the nature of a large epidemic with a lethality up to 5 percent. It should be noted that this was the first time in the history of cholera pandemics that the epidemic spread of diarrheal illnesses caused by non O1 serogroup 0139 cholera germ was observed. Specialists at the WHO believe that the spread of infections caused by this infecting agent will become a real possibility, just as happened in 1961 with El Tor cholera, which eventually led to the seventh pandemic. One confirmation of this forecast is the carrying of the infection from India into Russia (Rostov Oblast) and the development of three cases of infection in 1993.

Large outbreaks in Europe in 1988-1992 and in Romania in 1990 and 1991 (270 and 226 cases, respectively) were noted along with instances of cholera being carried into Great Britain, Switzerland, Germany, France, Spain, and other countries.

The situation with respect to a cholera epidemic in Russia and other CIS countries in 1988-1992 is as follows. Imported cases with outbreaks in several administrative territories of Russia, Ukraine, and Uzbekistan have been recorded. Activization of the epidemic process in Russia in 1990 on account of outbreaks in Stavropol Kray and Rostov Oblast has given way to the recording of single cases and instances of the infection being carried in from abroad. Specifically, in 1990-1993, cases of cholera being brought into Moscow, Bryansk, Ryazan, and Makhachkala from Ghana, India, and Pakistan (primarily by the tourist route) have been recorded. The subsequently recorded cases of the infection's spread (in Bryansk, Ryazan, and Makhachkala) have been linked to inadequate monitoring of arriving passengers and vehicles at points where the borders between Russia and countries with a cholera problem are crossed.

It should be noted that cholera germ is detected in the surface waters and other objects of the environment in various regions of Russia each year.

The cholera situation in Russia remains unstable, with a real threat that the infection will be carried in and outbreaks will develop in connection with an intensification of migration processes associated with flows of refugees, dislocation of military troops from CIS countries and the near abroad, and tourism (including tourism from countries with a cholera problem).

The cholera situation throughout the world and the prognosis regarding cholera infection thus continue to be bad in view of the development of secondary endemic foci on a number of continents and the real possibility of new instances of cholera being carried into different countries throughout the world.

### Conclusions

1. The progressive pandemic spread of cholera continues inasmuch as during the period of the seventh pandemic, cases of infection were recorded in the countries of South and Central America for the first time.
2. The increase in morbidity in the countries of Central and Eastern Africa is due to activation of cholera in endemic foci and pronounced migration processes.
3. In Asia, the cradle of the classic eltor cholera, the variant *Vibrio cholerae* non O1, serogroup 0139, has formed and caused large epidemics in India and Bangladesh that tend to spread in epidemic proportions.
4. In Russia, the cholera epidemic problem is primarily linked to cases of infection being imported from countries where cholera is a problem. It is therefore necessary to improve measures to protect territories against the import and spread of especially dangerous infectious diseases of humans.

### References

1. Sorok chetvertaya sessiya VOZ/ Stenogrammy plenarnykh zasedaniy. Doklady komitetov (Forty-fourth Session of WHO: Transcripts of Plenary Sessions, Committee Reports), Geneva, World Health Organization, 1992, pp 180-215. 2. "Cholera in 1991," WKLY. EPIDEM. REC., Vol 67, No 34, 1992, pp 253-259. 3. "Cholera in 1992," Ibid., Vol 68, No 21, 1993, pp 149-154. 4. B. Colfier, SCI. ET AVENIR, No 533, 1991, pp 12-35. 5. "Epidemic Diarrhoea due to *Vibrio cholerae* non O1," WKLY. EPIDEM. REC., Vol 68, No 20, 1993, pp 141-142. 6. S.M. Faruque, I. Albert, LANCET, Vol 339, No 8795, 1992, pp 740-741. 7. R.I. Glass, M. Libel, A.D. Brandling-Bennett, SCIENCE, Vol 256, June 12, 1992, pp 1524-1525. 8. S.A. McCarthy, R.M. McPhearson, A.M. Guarino, J.L. Gaines, LANCET, Vol 339, No 8793, 1992, pp 624-625. 9. D. Swerdlow, E.D. Mintz, M. Rodriguez, et al., LANCET, Vol 340, No 8810, 1992, pp 28-32. 10. I.K. Wachsmuth, C.A. Bopp, P.J. Feelds, Carrillo, LANCET, Vol 337, No 8749, 1991, pp 1097-1098.

### Socioeconomic Concept-Based System for Epidemic Process Simulations

957A0170B Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 3, May-Jun 94 (manuscript received 2 Apr 92) pp 44-49

[Article by O.V. Zakharyashcheva, V.N. Krutko, and B.L. Cherkasskiy, Systems Analysis Institute, Russian Academy of Sciences, and Central Scientific Research Institute of Epidemiology, Russian Federation State Committee for Sanitary-Epidemiological Oversight; first paragraph is verbatim ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII English abstract]

[FBIS Translated Text] In this paper different methods of modeling the epidemic process for different types of infectious diseases are discussed. We propose a concept of modeling for an essentially nonhomogeneous human population that takes into account biological, ecological, and social factors. An "epidemiological tree" method has been developed that makes it possible to divide the population into so-called "epidemiologically active groups." The method is invariant with respect to nosological forms. The paths of the spread of an infectious disease among the population are described in the form of an oriented graphic presentation of the interaction of individual epidemiologically active groups. The dynamic characteristics of the epidemic process are calculated by means of a system of differential equations. For illustration, the proposed approach is applied to human immunodeficiency virus [HIV] infection used as an example.

The purpose of this study is to develop and assess the basic principles of a unified methodology for formal description of an epidemic process. The fundamental distinguishing feature of the proposed methodology is that it attempts to create general methods of modeling the epidemic process of various infectious diseases based on the discovery and use of general laws of their development and spread in society.<sup>3,4</sup> Within the framework of this methodology, the epidemic component is considered from the standpoint of the socioeconomic and ecosystem levels. This makes it possible to, first, model the interaction of a population with an infecting agent and consider an entire spectrum of "allied" factors and, second, develop an interdisciplinary view of the epidemic process.

#### Materials and Methods

In accordance with the formulated task, systems analysis was the main investigatory method used in creating the models. Principles of the socioecologic conception of the epidemic process were used.<sup>5,6</sup> Above all, this made it possible to refrain from an "idealized" examination of the epidemic process,<sup>1</sup> i.e., one isolated from real conditions, and to instead consider the dynamics of an epidemic process' development together with those of other

factors and discover significant interconnections between the epidemic process and the environment. The results of the analysis performed are summarized in a schematic of the system of models of the dynamics of an epidemic process (Figure 1).

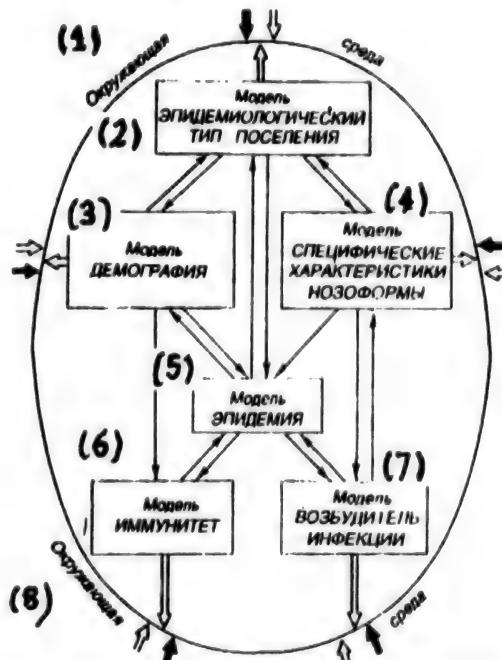


Figure 1. Schematic of the system of models of the epidemic process. (Light arrows indicate effects related to changes in the environment, and dark arrows indicate controlling actions.)

Key: 1, Environment; 2, Model: Settlement's Epidemiological Type; 3, Model: Demography; 4, Model: Specific Characteristics of Nosocomial; 5, Model: Epidemic; 6, Model: Immunity; 7, Model: Infecting Agent; and 8, Environment.

We will make several comments regarding the schematic presented.

First, expanding the frame in which an epidemiological system is perceived resulted in new ideas regarding the duration and periodicity of the epidemic process. We viewed it as a rather lengthy process characterized by the alternation of active and indolent stages. The active stage consists of a sharp increase in the number of infected and ill individuals in society or what is conventionally termed an outbreak of disease or epidemic. The indolent stage is that in which the disease either does not spread or does not spread intensively. Such a situation may be the result of a rather broad interlayer of nonsusceptible individuals and the presence of a low percentage of infected individuals or the impossibility of implementation of the infecting agent's transmission mechanism. A spontaneous change in the factors affecting such things

as people's immunity or the activity of transmission of the infecting agent, its properties, or demographic processes or the ecological situation may, however, push the epidemic process into an active stage simulated by the model titled *Epidemic*. The following models are expected to reflect the dynamics of changes in "allied" factors: *Immunity*, *Infecting Agent*, *Demography*, *Specific Characteristics of Nosoform*, and *Settlement's Epidemiological Type*. The latter model provides the characteristics of a society's conditions and lifestyle: the dynamics of the social and production infrastructure and the extent of socialization of labor, transport, and forms of recreation, which is especially important from an epidemiological standpoint. It also gives consideration to other conditions directly affecting the rate of an epidemic's spread.

Second, a systems view of the epidemic process has made it possible to resolve the question of the degree of aggregation of parameters, which for the case we are considering is essentially a question of the degree of the population's homogeneity. As follows from the schematic presented, the model titled *Epidemic* is influenced by various factors that result in the stratification of a society into groups at different levels of risk of becoming infected or infecting others. In most existing models, this fact is either bypassed by idealizing the process, which essentially results in adoption of the hypothesis that a population of people is homogeneous, or else is taken into consideration in some way with the groups being divided aystematically. It may be said that no objective method of dividing a population into epidemiologically meaningful groups exists at the present time.

The search for such a method led us to the idea of constructing what may be called an "epidemiological

tree." It may be used to develop a hierarchy of factors and identify potentially epidemiologically active groups of people. The tree's root is the nosologic form under consideration. The next level is its characteristic mechanism of transmission of the infecting agent. Following that level is a level describing those components of the environment that are active in implementation of the transmission mechanism and a level of epidemiologically significant social factors causing humans to interact with the specified components of the environment. Finally, the last level is that of those groups of people who are affected by the specified social factors. These groups are termed epidemiologically active groups. Figure 2 is graphic representation of an epidemiological tree.

In terms of epidemiologically active groups, one can model an epidemic as a process of transmission of infecting agent between and/or within the said groups through shared environmental components. The model titled *Epidemic* is thus the key system-forming element of the system of models. During the indolent stage, when the mechanisms of the model *Epidemic* have not been activated, information about the changes occurring in other models is gathered. The mechanisms of an infection's spread may be triggered, i.e., the model titled *Epidemic* may be initiated, when a specified cumulative effect is achieved.

We will pause for a more detailed examination of the factors included in an epidemiological tree. We will begin with those mechanisms of an infecting agent's transmission that have been well studied and systematized in the literature. We have used the generally accepted classification system formulated by L.V. Gromashevskiy<sup>2</sup> and will supplement it with a fifth, i.e.,



Figure 2. Epidemiologic Tree.

Key: 1, Nosologic form; 2, Mechanism of transmission; 3, Component of the environment; 4, Epidemiologically significant social factor; and 5, Epidemiologically active group.

vertical, mechanism of transmission of an infecting agent (from parents to offspring). It is important to mention that there are many infectious diseases whose infecting agents are propagated by several transmission mechanisms. Three of the five transmission mechanisms (airborne droplet, fecal-oral, and transmissive) inevitably include a phase of having a portion of the infecting agent population be present in the components of the

environment surrounding the human host. In taking the next step toward generalization for the case of the contact and vertical mechanisms of transmission, however, we will examine the human population itself as a component of the environment. The human population thus has the double function of a biological host and component of the environment. Table 1 presents a classification of the main epidemiologically significant components of the environment.

**Table 1. Types of Environmental Components and Their Significance in the Realization of Different Mechanisms of Transmission of Infecting Agent**

Component	Significance of Component for Transmission Mechanism				
	AD	FO	TR	CN	VR
<b>Biotic environment:</b>					
Components in populated areas:					
Fauna	-	+	+	-	-
Population	-	-	-	+	+
Components away from populated areas:					
Fauna	-	+	+	-	-
<b>Abiotic environment:</b>					
Components in populated areas:					
Water	-	+	-	-	-
Air	+	-	-	-	-
Soil	-	+	-	-	-
Food	-	+	-	-	-
Sewage treatment equipment	-	+	-	-	-
Water lines	-	+	-	-	-
Medical instruments	-	-	+	-	-
Household items	-	+	-	-	-
Components away from populated areas:					
Water	-	+	-	-	-
Air	♦	-	-	-	-
Soil	-	+	-	-	-
Food	-	+	-	-	-

Note: AD = airborne droplet; FO = fecal/oral; TR = transmissive; CN = contact; and VR = vertical.

The next step in the study is that of establishing links between individual epidemiologically active groups and fixing the links in the form of an adjacency matrix. Next, the adjacency matrix is used as the basis for plotting a directed graph (digraph) of the epidemic's spread. The vertices are the epidemiologically active groups, and the arcs indicate the possibility of transmission of the infecting agent from one group to another. Spread of the infection within a group is fixed in a graph of loops. The resultant digraph is the basis of the model titled Epidemic.

Two types of information obtained from the epidemiological tree are used to establish links between groups. First, there is the presence of intersecting or coinciding groups of population members, which is evidence of the existence of common links (groups of population members) involved in different mechanisms of the infecting

agent's transmission. Second, there is the presence of an environmental component that a certain set of groups share in common and that will result in the groups of the said set being infected if a transmission mechanism allowing both inoculation of the environmental component by some group and infection due to it is realized.

The directed graph clearly shows possible routes of the infection's spread from group to group. Obviously, the specific path taken by a process of infection of the population will depend on which group receives the initiating impulse.

The quantitative methods used in the model titled Epidemic to calculate process dynamics call for ascribing a whole series of parameters to each vertex and arc.



**Figure 3. Epidemiological tree of HIV infection. (Conventions in Figures 3 and 4 are as indicated in the text.)**

Key: 1, HIV infection; 2, vertical; 3, transfusion; 4, contact; 5, susceptible population; 6, medical equipment; 7, susceptible population; 8, women's right to bear children; 9, presence of heterosexual relations; 10, presence of prostitution in society; 11, presence of drug addiction in society; 12, cosmetic procedures; 13, treatment in hospitals and polyclinics; 14, mandatory vaccination of children and other mandatory procedures (analyses, etc.); 15, blood transfusion and transplantation; and 16, presence of homosexual relations.

Among the said parameters are the following: the size of the group, the number of noninfected susceptible individuals and infected individuals in that group, and the number of inert group members not involved in the epidemic process, as well as coefficients of the interaction of individuals of one group with another, the rate at which the inert interlayer is filled, etc. The epidemic process occurring will be described by that number of differential equation systems that is equal to the negative power of the vertex corresponding to the said group, including its loop. In other words, each equation system applies to only one arc entering a vertex. The complexity associated with the large dimensionality of the problem may be resolved successfully by computer simulation.

#### Results and Discussion

To test the methodology under discussion, we selected the nosologic form HIV infection, which is being studied extensively at the present time. Figure 3 presents one possible version of a tree for HIV infection. Roman letters are used to designate the following epidemiologically active groups: w, women of childbearing age (15 to 50 years old); y, infants and young children (0 to 3 years old); n, narcotics addicts (13 to 50 years old); k, women going to beauty salons (16 to 65 years old); a, medical personnel at medical departments (16 to 65 years old); b, children in hospitals (0 to 15 years old); p, adults in hospitals (16 to 80 years old); c, nurses performing procedures in pediatric polyclinics (16 to 65 years old); d, children receiving vaccinations (0 to 16 years old); i,

blood and organ donors (18 to 45 years old); h, young boys suffering from hemophilia (0 to 15 years old); j, men suffering from hemophilia (16 to 65 years old); r, children with transplanted organs (0 to 15 years old); u, adults with transplanted organs (16 to 65 years old); f, adolescents embarking on sexual activity (13 to 18 years old); l, moderately sexually active adults (18 to 65 years old); o, homosexual prisoners (13 to 65 years old); g, homosexual soldiers (18 to 35 years old); x, homosexuals in civilian society (13 to 65 years old); m, prostitutes (16 to 40 years old); and s, men with irregular behavior (18 to 65 years old).

Figure 4 presents a directed graph of the spread of HIV infection throughout the population. The digraph is strongly connected (i.e., for each pair of different vertices u and w, there is a route from u to w and from w to u). From a semantic standpoint, this means that an epidemic beginning in any of the epidemiologically active groups will eventually encompass all other groups. Of course, this fact is not very comforting. By analyzing the resultant graph, however, one can identify arcs whose removal will relieve the digraph of its property of strong connectedness. Examples of such arcs are the respective vertex pairs b and a and d and c. If these two arcs are removed, an epidemic beginning in one of the "pediatric" groups (r, h, b, d, or y) will not spread to the "adult" groups. The presence of these two arcs means that medical personnel may contract the infection from asymptomatic HIV-positive children in medical institutions (polyclinics and hospitals). The routes of spread of

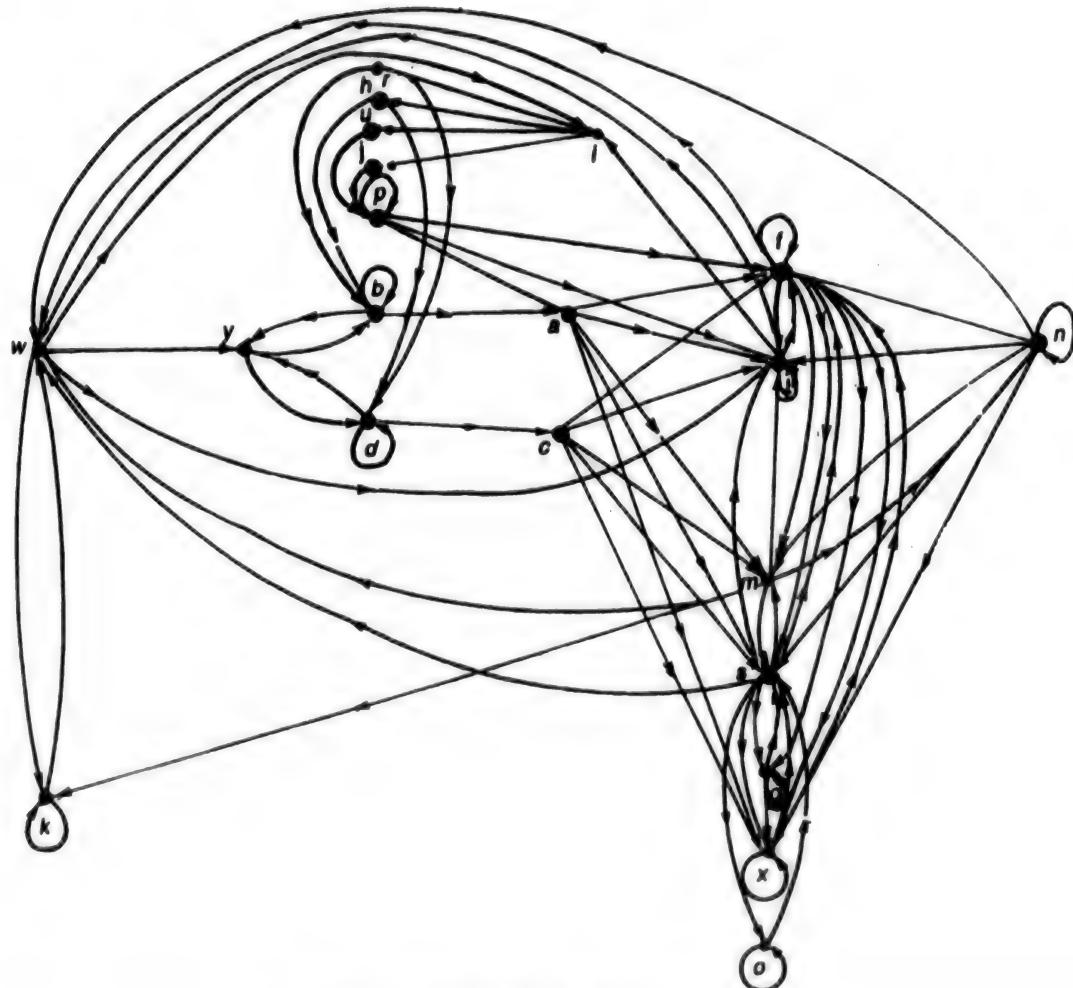


Figure 4. Digraph of the spread of HIV infection.

infection described by the arcs (b, a) and (d, c) lend themselves to effective control, however, and scenarios in which measures protecting medical personnel are painstakingly adhered to are entirely realistic. If such measures were to be fully implemented, any such epidemiologically dangerous social factor as providing treatment and performing procedures in hospitals and polyclinics not just on children but also on members of the epidemiologically active groups a, b, p, c, and d would disappear.

In just what scenario would an epidemiologically active group cease being epidemiologically active? The factors included in the epidemiological tree are essentially the reasons for the occurrence of such groups. Analysis of the said factors makes it possible to develop a set of measures neutralizing their effect. The higher the level of the factor at which antiepidemic measures are being directed, the more groups that can be excluded from the epidemic process. The result is simplification not only of

the epidemiological tree but also of the digraph of the disease. Even in the initial stages of research, it is thus possible to assess the effectiveness of preventive measures by using simple graph models (the epidemiological tree and digraph of the disease's spread). To date, we have developed software making it possible to implement this set of operations and play out possible scenarios of the implementation of measures to prevent infectious diseases.

As the example presented demonstrates, the topology of a digraph corresponding to one disease may vary because it will depend on biological and social characteristics subject to control and change. We will note that in addition to strongly connected graphs, which obviously mainly describe airborne droplet infections, there can also be unilaterally connected graphs. They differ from strongly connected graphs by virtue of the fact that for any two of their vertices, at least one must be reachable by the other. In such a case, the given nosology will

include epidemiologically active groups that do not infect other groups but that are themselves at risk of becoming infected. This means that once an epidemic process has begun in such groups, it will not spread any farther. Another possible variant is the case in which a digraph describing the spread of a disease consists of several connectivity components. In such a case, we will be dealing with a "local" infection that, having arisen in one group, will not extend beyond the bounds of some subset of groups representing the connectivity component in the digraph. In special cases, a single group may constitute such a component.

### Conclusions

1. A concept for modeling the epidemic process for a highly inhomogeneous population of people has been proposed that gives consideration to biological, ecological, and social factors such as components of a socioecologic system.
2. It has been shown that the methodological technique developed, i.e., constructing an epidemiological tree of the disease, makes it possible to systematize the redistribution of a population into epidemiologically active groups. The method is invariant to the nosologic form.
3. A scheme has been proposed for simulating the spread of an infectious disease based on plotting a digraph of the interaction of individual epidemiologically active groups and differential equation systems to compute an epidemic's dynamics based on each of the graph's arcs, including its loops.
4. Combining qualitative analysis, expert evaluations, and quantitative computation methods makes it possible to say that the method provides high solvability with respect to prognostic problems.

### References

1. V.D. Belyakov, A.N. Gerasimov, Yu.V. "Mathematical Model of Epidemic Process of Anthroponotic Infection Given Stable Factors." *ZHURN. MIKROBIOLOGII*, No 3, 1991, pp 29-32
2. L.V. Gramashevskiy. *Obshchaya epidemiologiya* (General Epidemiology). Moscow, 1965
3. O.V. Zakharyashcheva, V.N. Krutko, A.V. Mamay, B.L. Cherkasskiy, "Simulation Approach to Prediction and Management of Dynamics of Epidemic Process." *Dokl. Mezhd. semin. YuNESKO "Tekhnicheskiye, psichologicheskiye i pedagogicheskiye problemy sozdaniya i ispolzovaniya avtomatizirovannykh sistem"* (Report of UNESCO International Seminar "Technical, Psychological, and Pedagogical Problems in the Creation and Use of Automated Systems"). Moscow, 1990.
4. V.N. Krutko, O.V. Zakharyashcheva, and A.V. Mamay, "Conceptual Model of the Dynamics of an

Epidemic Process," *XXVII Vses. syezda epidemiol., mikrobiol. i parazitol* (Report of 27th All-Union Conference of Epidemiologists, Microbiologists, and Parasitologists), Alma-Ata, 1989.

5. B.L. Cherkasskiy, "Global Level of an Epidemic Process," *Akтуальные проблемы эпидемиологии, клиники, лечения и профилактики тропических заболеваний. Мат. II Всес. конферен.* (Current Topics in Epidemiology, Clinical Observation, Treatment, and Prevention of Tropical Diseases. Materials of Second All-Union Conference), Moscow, 1984.
6. B.L. Cherkasskiy, *Sistemnyy podkhod v epidemiologii* (Systems Approach in Epidemiology), Moscow, 1988.

### Case of Laboratory Marburg Fever Infection

*957A0170C Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLGII in Russian No 3, May-Jun 94 (manuscript received 6 Feb 92) pp 104-106*

[Article by V.V. Nikiforov, Yu.I. Turovskiy, P.P. Kalinin, L.A. Akinfeyeva, L.R. Katkova, V.S. Barmin, Ye.I. Ryabchikova, N.I. Popkova, A.M. Shestopalov, V.P. Nazarov, S.V. Vedishchev, and S.V. Netesov, Institute for Advanced Training, TsMSCh (not further identified) No. 165, All-Russian Institute of Molecular Biology, Vektor Scientific Production Association, Novosibirsk]

[FBIS Translated Text] Marburg viral disease was first described as an independent nosological form in 1967, when 31 cases of the disease were established in the cities of Marburg and Frankfurt (Germany) and later in Belgrad (Yugoslavia). Afterward, three cases were noted in South Africa in 1975, and one case was noted in 1982. Two cases were observed in Kenya in 1980. Of the 37 patients, 9 died.<sup>1</sup>

It is at present difficult to name a disease for which blanks spots exist as to the natural reservoir of the infection, its transmission routes and infection mechanisms, variations in its clinical course, treatment approaches, etc.

Nevertheless, there are no available publications on the topic in the open domestic and foreign literature. In view of this fact, the one case of the infection that occurred in our laboratory is of undoubted interest because it provides more or less reliable answers to many of the aforementioned questions.

Patient V. is a 35-year-old junior scientific associate who was admitted to the hospital at 7:30 A.M. on 16 April 1990 with complaints of malaise, a body temperature of 38-39°, a body rash, a headache, back muscle pain, loss of appetite, nausea, and dryness in the mouth. His illness had become acute during the latter part of the day on 13 April 1990, when he felt fatigue and chills. At first, his body temperature rose, reaching 38.7°C by night. The pain in his back muscles and his headache increased. He

did not see a physician for the next 2 days, but instead took fever-reducing drugs on his own. He did not feel any better, however. In addition to his described symptoms, he began suffering from anorexia. On 16 April 1990 at about 6 A.M. he noticed a skin rash and was taken to the hospital by ambulance.

He lives in a private one-room apartment with his wife and 4-year-old daughter. It is clear from his medical history that he had come into contact with a culture of Marburg virus during the course of his work. On 11 April 1990, he had violated safety rules for handling the blood serum of a laboratory animal infected with the said virus because he believed that the material was no longer infectious in view of the fact that it had been stored at a temperature of 4°C for about 6 months (it had an initial activity of  $1 \times 10^7$  blast-forming units/ml). Believing his illness to be a common cold, he did not take any counterepidemic measures. Instead, after feeling fatigued during the day of 13 April 1990, he went home without informing the medical service that cares for the laboratory of his problem. On 14 April 1990, he received 10 visitors at his home. Thus before being hospitalized, he had been in close contact with 12 relatives (he spent the entire day before his hospitalization with his wife and daughter and had had 10 visitors on 14 April 1990). He spent the morning of 13 April 1990 in a laboratory building where an additional 58 people work. In addition, he could have had a whole series of unestablished contacts on his way home from work (in other buildings of the scientific research institute, on public transportation, etc.).

Those of his relatives with whom he had been in direct contact were released from work until 7 May 1990 (the maximum incubation period duration) as a preventive measure. Isolation conditions were set up for them in their homes, and they were visited by a physician twice each day.

The aforementioned 58 coworkers were not offered isolation; however, until 5 May 90, they too were examined by physicians and had their temperatures taken twice each day (morning and evening).

At the time of his admission, the patient's condition was listed as moderately serious. The patient was listless, in poor spirits, and clearly frightened by his condition. His body temperature was 37.8°C. On the skin of his upper extremities (mainly on their extensor surfaces), neck, torso, and upper half of his thigh, he had a rash with a hemorrhagic component that protruded somewhat above the surface. There was no thickening of the rash in the creases of his skin, and his feet and hands were free of rash. His face was also free of any rash, and he was pale. His manifestation of the symptoms of "braids" and "nips" was only slight. He had a slight white dermographism with long occult and short overt periods. His skin was warm and dry. His conjunctivae were moderately hyperemized. His tongue was thickly coated with a dirty white film; however, the tip was clear. In his mouth there was marked congestive hyperemia of the soft palate and

palantine arch and petechial hemorrhages. His mandibular lymph nodes were significantly enlarged, as were his inguinal lymph nodes, albeit to a lesser extent. Among other noteworthy changes in his condition were tachycardia to 104 beats/min and swelling of his liver, the edges of which were palpated 0.5 to 1.0 cm below his costal arch.

General analysis of his blood and urine did not reveal any pathological changes. Biochemical analysis of his blood revealed a pronounced elevation in aminotransferase activity (an alanine aminotransferase [ALT] level of  $2.1 \mu\text{mol/lch}$  [not further identified] and an aspartate aminotransferase [AST] level of  $2.5 \mu\text{mol/lch}$  as opposed to normal levels of  $<0.6 \mu\text{mol/lch}$ ).

In view of the aforesaid clinical-epidemiological data, it was hypothesized that the patient had Marburg hemorrhagic fever. Samples of the patient's blood and urine were taken along with a smear from his nasopharynx for virological and serological confirmation of the diagnosis. Later, the said samples were collected regularly. Pathogenetic and symptomatic therapy was ordered for the patient (in view of the length of time before the patient sought treatment, it was decided to refrain from giving him injections of specific heterologous  $\gamma$ -globulin, interferon, and virazol [transliteration]). Despite the therapy administered, the patient's condition continued to worsen during his first few days in the hospital. The rashes on his neck and torso merged and began to appear raspberry colored with small light "clear spots." Partial filling in of the rash on his forearms and thighs was noted. Numerous small hemorrhages arose at the sites where the braid was superimposed. He had one instance of liquid stool without any pathological impurities. In view of this fact, even though the available clinical literature did not contain any mention of the possibility of using efferent detoxication methods with the given pathology, the patient was subjected to hemosorption (hemosorbent FA-S). As a result, he began to feel better in general, his fever decreased, and the number and brightness of elements of his rash decreased.

In the smears from his nasopharynx on 16 April 1990, a clear illumination of the cylindric epithelium was observed when the smears were tested in an indirect immunofluorescence reaction with a noncommercial rabbit immune serum against Marburg virus and antispecies luminescent serum. At the same time, the negative results of a study of smears from his nose that were collected on 17 April 1990 and studied in a fluorescing antibodies reaction for adenovirus (types 3, 6, and 7), influenza A and B, and parainfluenza (types 1, 2, and 3) made it possible to exclude acute respiratory infection from the patient's diagnosis.

On 20 April 1990, the patient's condition once again began to worsen progressively. He became prostrate and oblivious to his condition. Fresh elements of hemorrhagic rash appeared, hematomas appeared at the sites where he had received injections, his axillary lymph

nodes grew larger, his liver grew painful on palpation, and the edge of his liver increased to 1.5-2.0 cm below the edge of his ribs. The results of biochemical analysis of his blood were as follows: total protein, 64.5 g/l; albumin, 57 percent;  $\alpha$ -globulin, 13.4 percent;  $\beta$ -globulin, 18.7 percent;  $\gamma$ -globulin, 10.9 percent; ALT, 2.1  $\mu\text{mol/lch}$ ; and AST, 1.9  $\mu\text{mol/lch}$ . The titer of his antibodies against Marburg virus in an enzyme immunoassay reached 1:64,000 versus 1:1,000 on 16 April 1990. In other words, it increased by a factor of 64. A repeat of the hemosorption procedure (21 April 1990) provided only a temporary improvement in the way he felt, whereas his hemorrhagic syndrome continued to grow more evident. New elements of his rash appeared, and the number of postinjection hematomas increased. His biochemical disturbances grew increasingly evident (ALT, 2.6  $\mu\text{mol/lch}$ ; AST, 1.6  $\mu\text{mol/lch}$ ; total protein, 62 g/l; albumin, 54 percent;  $\alpha$ -globulin, 12.4 percent;  $\beta$ -globulin, 14.2 percent;  $\gamma$ -globulin, 24.5 percent; ethanol test, positive; and fibrinogen, 4.4 g/l). In view of his worsening objective indicators, he was subjected to plasmapheresis (Gabro PF-04 filter) on 23 April 1990, after which his condition improved "abruptly." His physical activity increased sharply, he regained his appetite, his fever disappeared, his postinjection hematomas decreased, and the rash on his body began to subside. In view of the changes detected in his biochemical blood indicators, heparin, plasma, and amino acid solutions were added to his treatment.

Guinea pigs infected with the patient V.'s blood and urine and the smear from his nasopharynx all died on 24 April 1990. On the same day, ultrathin sections of the liver and spleen of guinea pigs infected with the smear from the patient's nasopharynx collected on 16 April 1990 were found to contain Marburg virus of the typical morphology. The presence of Marburg hemorrhagic fever in patient V had thus been confirmed by laboratory studies.

The patient's condition deteriorated successively and he began feeling worse on 29 April 1990, at which time his body temperature again increased (to 37.6°C) and his general toxicosis syndrome became more pronounced. In view of this fact, plasmapheresis was repeated and once again produced a positive effect that turned out to be persistent, i.e., to last for the next month (to 0.1 June 1990). A steady, albeit slow, trend toward resolution of the process occurred: The patient's hemorrhages began to be resorbed, his lymphadenopathy disappeared, his liver grew smaller, and his biochemical blood indicators became practically normal.

On the evening of 1 June 1990, however, his body temperature rose once again (to 37.2°C). By the next morning he had become listless, adynamic, and depressed. His fever reached 38.1°C, his head began to ache, he began experiencing pain in the muscles of his shoulder girdle, and hyperemia developed in his mouth. These symptoms were considered a relapse of the basic process. A set of virological tests was again ordered for the patient. Despite the massive detoxication therapy



**Figure 1. Marburg virus in the liver of a guinea pig infected with the blood of patient V. Arrows indicate virus particles. Magnification, 20,000x.**

involving colloidal and crystalloid solutions received by the patient, his condition subsequently deteriorated progressively until it was listed as grave on 4-5 June 1990. The clinical symptoms of the relapse differed from those of the primary wave of disease in that the patient had no rash but instead manifested sharply pronounced unilateral orchitis (his inflamed testicle became more than four times larger than his intact testicle). At the same time, significant (by a factor of 3-4) elevation of his ALT and AST activity was observed, and his ethanol test was positive. On 3 June 1990, hemosorption was performed. It yielded only a slightly positive effect. Three subsequent plasmapheresis procedures (on 4, 5, and 6 June 1990) had a "limiting" effect on the course of the process. By 9 June 1990, the patient's condition and the way he felt could already be evaluated as satisfactory: His fever had disappeared, he had become active; his appetite had returned, and the symptoms of his orchitis had resolved.

The patient was kept in the hospital a while longer because of epidemic indications and because of the need to complete virological studies because the preparations obtained from guinea pigs infected on 28 June, 30 June, and 8 July 1990 with the patient's sperm exhibiting specific antigen (Marburg) in a complement-binding reaction.

The patient was released on 14 Aug 1990 in satisfactory condition without any residual symptoms on day 123 of his hospital stay when the results of the virology studies came back negative.

The small number of detailed clinical-epidemiological observations of individuals with Marburg virus and the

uniqueness of this case, in which the source and time of infection and duration of the incubation period were known exactly, changes in the patient's condition and in the way he felt were painstakingly followed throughout the entire course of his disease, and clinical and virological laboratory studies were conducted in dynamics, enabled us to formulate and emphasize several important characteristic features in development of the disease process in patient V and to draw a number of conclusions that are, naturally, open to discussion. Thus even in the early stages of the disease, virus was detected in patient V's blood and urine and in smears from his nasopharynx; however, no transmission of the disease from person to person occurred by either the everyday contact route or the airborne particle route even though the patient had had close contacts with relatives. (Physician observation and isolation of those of the patient's coworkers and relatives with whom he had come into contact were halted on 5 May and 7 May 1990, respectively.) Not one single case of development of the specific process was recorded. This fact has allowed us to recommend reconsidering existing rules regarding setting up a regimen in departments where patients with the said pathology are concentrated. At the same time, the very fact of the infection of patient V confirms that Marburg virus may be preserved in biological substrates for an extremely long time without any significant loss of infectiousness.

The disease developed in a waveform manner; however, it is difficult to state unequivocally whether this phenomenon was the result of using extracorporeal detoxication methods (after the respective measures were taken, the patient's condition improved and he felt better). Judging by the results obtained, the use of efferent detoxication methods in the comprehensive treatment of patient V turned out to be justified inasmuch as from an efficacy standpoint, hemosorption proved to be far inferior to plasmapheresis. In view of this fact and the communality of many pathogenetic forces, there are grounds for recommending the use of plasmapheresis during the treatment of patients with Lassa and Ebola hemorrhagic fevers.

Especially important among the diverse clinical symptoms of our patient's disease were the following indications of nervous system damage: listlessness, deafness, apathy, and obliviousness to his condition. These symptoms could possibly be considered pathognomonic for Marburg fever.

The dynamics of the titers of the specific antibodies in the blood of patient V were clearly consistent with the periods of the disease and were markedly elevated during those periods when the disease was at its greatest peak (the main wave and relapses). This characteristic feature may possibly be used in the future for prognostic purposes.

Patient V's clinical recovery was largely dictated by total cleansing of the infecting agent from his body. In view of

this fact, exhaustive virological studies of the convalescent are needed before any definitive conclusions can be drawn.

The authors thank L.S. Sandakhchiyev for his assistance in writing this report.

#### Reference

1. Viral Hemorrhagic Fevers. WHO Expert Committee Report, WHO, Geneva, 1986, pp 74-84.

#### Experimental Substantiation of the Use of Pharmaceuticals To Increase the Human Body's Resistance to the Combined Effect of Carbon Monoxide and Hyperthermia

957A0346A Moscow MEDITSINA TRUDA I PROMYSHLENNAYA EKOLOGIYA in Russian No 9-10, Sep-Oct 93 (manuscript received 18 May 92) pp 10-11

[Article by A.V. Sedov, T.A. Lukicheva, N.A. Surovtsev, A.V. Akinshin, L.Yu. Nazarov, and S.V. Miroshnik, Zashchita Special Expert Medical Care Center]

[FBIS Abstract] The feasibility of using pharmaceuticals to boost the human body's resistance to the combined effects of carbon monoxide and hyperthermia was studied in a total of 66 experiments involving 10 volunteers who were placed into a hermetically sealed chamber under conditions of a heating microclimate (ambient air temperature of +50 +/- 2°C, relative humidity of 20 +/- 5 percent, and air flow rate of 0.1 m/s). The air available for them to breathe contained CO in a concentration of 300 +/- 10 mg/m<sup>3</sup>. Four series of experiments were performed. Directly before the various series of experiments, the volunteers took the following pharmaceutical agents: series 1, placebo; series 2, bemethyl in a dose of 0.5 g; series 3, bromantan in a dose of 0.25 g; and series 4, a combination of 0.5 g of bemethyl and 0.25 g of bromantan. A double-blind control method was used in all four series of experiments. The combination of CO and a heating microclimate induced changes in the study subjects' cardiorespiratory system that varied depending on the pharmaceutical administered. Those subjects who received the placebo had higher minute respiratory volumes and experienced more rapid increases in heart rate than occurred in those subjects who were administered bemethyl, bromantan, or a combination thereof. By 2 hours after the experiment had begun, the subjects in series 1 had a heart rate of 33 beats/min, whereas those subjects in series 2, 3, and 4 had heart rates of 23, 22, and 24 beats/min. The CO-induced decrease in systolic and diastolic arterial pressure was virtually identical in all four groups. The rate at which a critical body heat developed depended both on the pharmaceutical administered to them and on their starting body temperature. The combination of bemethyl plus bromantan significantly delayed the onset of critical body temperature (hyperthermia). In those individuals who received a placebo, hyperthermia developed 138 +/- 10 minutes

after the experiment had begun. In those individuals who received bemethyl or bromantan alone, hyperthermia developed 167 +/- 12 and 156 +/- 14 minutes into the experiment, respectively. In those individuals receiving a combination of bemethyl plus bromantan, hyperthermia developed 168 +/- 8 minutes after the start of the experiment. References 4: Russian.

**RF Ministry of Health Announcement to Directors of Health Care Organizations**

957A0347A Moscow MEDITSINA TRUDA I PROMYSHLENNAYA EKOLOGIYA in Russian No 9-10, Sep-Oct 93 p 46

[Russian Federation Ministry of Health announcement dated 21 Oct 92 from V.I. Starodubov, Russian Federation deputy minister of health, to directors of health care organizations]

[FBIS Translated Text] The Russian Federation Ministry of Health considers it necessary to call your attention to the negative attitude that has developed toward the problem of organizing medical and preventive care provided to individuals suffering from occupational diseases.

Incoming communications have noted a decrease in the number of available cots in occupational pathology departments and even their elimination in some territories.

At the same time, the level of occupation-related morbidity in Russia in 1990 was 44.12 percent higher than in 1989, and no trend toward a decrease was evident in 1991.

An increase in occupation-related diseases has been noted in both industrial enterprises and in agriculture throughout all regions of the Russian Federation. Thirty percent of patients suffering from occupation-related diseases are women. The percentage of patients with persistent disability is high.

Workers in the national economy continue to be subjected to a set of hazardous industrial factors that are a source of constant risk of development of occupation-related disease.

Under these conditions, I consider it unacceptable to destroy either the established structure of providing medical care to patients with occupation-related disease or the system of prevention, discovery, and rehabilitation of occupation-related diseases.

Matters of financing the specified subdepartments must be resolved together with unions by bringing in the resources of economic structures with all forms of ownership.

BULK RATE  
U.S. POSTAGE  
PAID  
PERMIT NO. 352  
MERRIFIELD, VA.

This is a U.S. Government publication produced by the Foreign Broadcast Information Service (FBIS). Its contents in no way represent the policies, views, or attitudes of the U.S. Government.

FBIS collects, translates, disseminates, and analyzes foreign open-source information on behalf of the U.S. Government. Its publications may contain copyrighted material. ***Copying and dissemination is prohibited without permission of the copyright owners.***

- Bracketed indicators before the first sentence of each item describe the way in which the material was processed by FBIS.
- Headlines and all bracketed explanatory notes are supplied by FBIS.
- Personal and place names are rendered in accordance with the decisions of the U.S. Board on Geographic Names as adapted by FBIS. Unverified names in radio and television material appear in parentheses and are spelled phonetically; words and phrases in parentheses preceded by a question mark are unclear in the original and deduced from context.

### **SUBSCRIPTION INFORMATION**

#### **U.S. Government Customers**

For a list of FBIS products, to subscribe to an FBIS publication, or to indicate a change of address contact:

FBIS  
P.O. Box 2604  
Washington, DC 20013-2604  
Telephone: (202) 338-6735  
FAX: (703) 733-6042

#### **Non-Government Customers**

Subscriptions are available from the National Technical Information Service:

NTIS  
5285 Port Royal Road  
Springfield, VA 22161  
Telephone: (703) 487-4630  
FAX: (703) 321-8547

New subscribers should expect a 30-day delay in receipt of the first issue.

**END OF**

**FICHE**

**DATE FILMED**

9 MAY 1995